

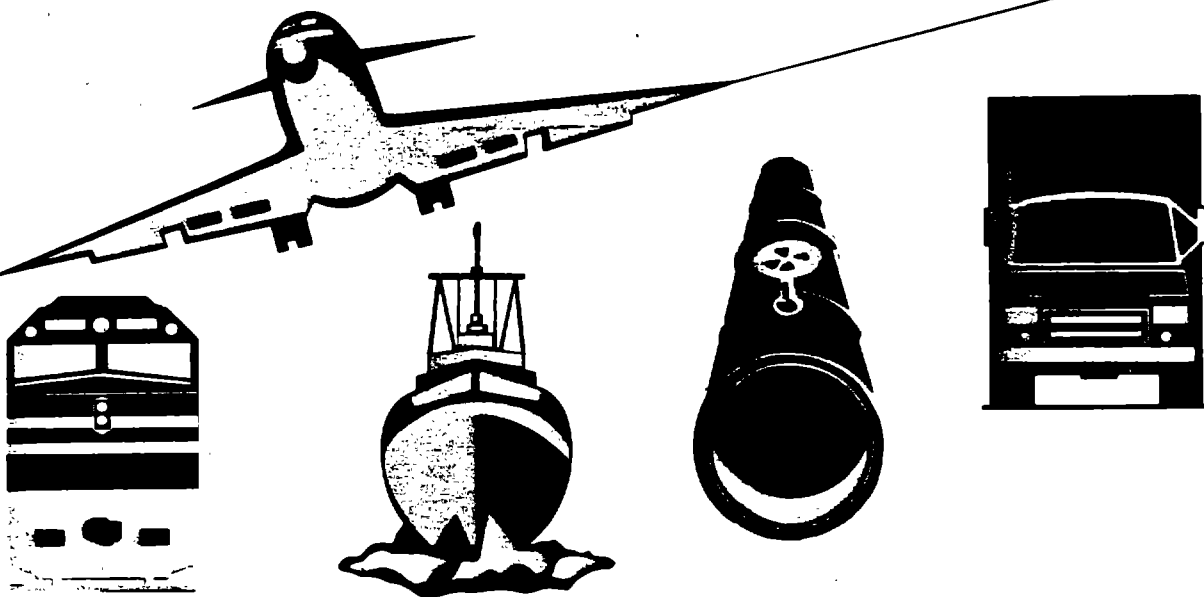
NATIONAL TRANSPORTATION SAFETY BOARD

PB98-916610



TRANSPORTATION SAFETY RECOMMENDATIONS

**ADOPTED DURING THE MONTH
OF OCTOBER, 1998**



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National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: October 7, 1998

In reply refer to: A-98-87

Honorable Jane F. Garvey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On February 8, 1997, about 1935 Atlantic standard time, a Cessna 402, N318AB, operating under the provisions of Title 14 Code of Federal Regulations (CFR) Part 135 as Air Sunshine flight 319, crashed into the Caribbean Sea southwest of St. Thomas, U.S. Virgin Islands. The flight had been a regularly scheduled flight operating under visual flight rules (VFR) between St. Thomas and St. Croix. The airplane was destroyed; two passengers were killed, and the pilot and two of the remaining four passengers sustained minor injuries. Night, visual meteorological conditions prevailed at the time.

The pilot, who had accrued over 11,000 hours in the 400-series Cessna airplane types, mostly in the south Florida area, had begun flying in the Caribbean area less than a week before the accident. The pilot estimated that he had executed between 10 and 15 approaches to St. Thomas, with 4 or 5 of those at night. The pilot told Safety Board investigators that, at the time of the accident, he was unable to receive the distance measuring equipment¹ signal from St. Thomas. Consequently, he was especially attentive to receiving and establishing the proper localizer² course to St. Thomas to remain clear of the mountains on the north side of the island. The pilot said that he encountered some difficulties receiving the radio signal and was attempting to adjust the localizer course setting. During this time, the pilot noticed that the airplane was passing through 1,100 feet mean sea level. The pilot said that he refocused on the localizer and then the airplane struck the water about 3 miles from shore.

According to the pilot's account of the accident, the sky was dark and few or no lights were visible over the water. The evidence suggests that the absence of visual cues caused by the combination of dark sky and darkness over the water produced a "black hole" effect in which the pilot lost a visual sense of the airplane's height above water. As a result, the pilot misjudged the airplane's distance from the island and height above the water. Further, because the flight was conducted under

¹ Distance measuring equipment provides accurate information on the distance of the airplane from a properly equipped navigation aid.

² The localizer is a component of the instrument landing system that provides the pilot with lateral information.

VFR, the pilot had no assistance from air traffic control (ATC) regarding proximity to the surface, despite the approach path being within an area of ATC radar coverage. Had the pilot operated under instrument flight rules (IFR), radar would have enabled the controller to monitor the flight's altitude, as well as its position.

Radar advisories were also available to flights operating under VFR in the St. Thomas area. However, unlike IFR operations, VFR flights do not operate on standard routes with minimum safe altitudes that are published for pilots and controllers to use. As a result, controllers do not have a criterion for identifying VFR flights that are operating at unsafe altitudes. Further, the St. Thomas ATC facility incorporated the minimum safe altitude warning (MSAW) system, which is designed to alert a controller if an airplane descends prematurely toward terrain or water. However, to reduce the frequency of nuisance MSAW alerts from VFR flights operating below minimum IFR altitudes, the St. Thomas ATC radar MSAW system was configured by the Federal Aviation Administration (FAA) to alert controllers only about flights operating under IFR. The Safety Board notes that the FAA's configuration of the MSAW to exclude VFR operations is not unique to the St. Thomas ATC facility.

Although current rules allow aircraft used to provide scheduled passenger services under 14 CFR Part 135 (aircraft with fewer than 10 passenger seats) to be operated under VFR, the Safety Board is concerned that visual flight operations at night may impose incremental risks on users of these services. The hazards of night flight over large bodies of water have been recognized by the FAA and addressed in its Aeronautical Information Manual (AIM). The AIM section titled "Official Guide to Basic Flight Information and ATC Procedures" states the following:

Featureless terrain illusion—An absence of ground features, as when landing over water, darkened areas, and terrain made featureless by snow, can create the illusion that the aircraft is at a higher altitude than it actually is. The pilot who does not recognize this illusion will fly a lower approach.

The Safety Board previously addressed the risks of operating scheduled passenger flights under VFR in its investigation of a 1989 accident involving a DeHavilland DHC 6-300, conducted under 14 CFR Part 135, that crashed into the side of a mountain in Molokai, Hawaii, while the pilot was attempting to operate under VFR during IFR conditions.³ As a result of that accident, in Safety Recommendation A-90-137, the Safety Board urged the FAA to require that scheduled 14 CFR Part 135 operations of turbine-powered or multiengine airplanes be conducted under IFR during hours of darkness or whenever visibilities less than 3 miles or ceilings less than 1,000 feet are forecast, reported, or encountered. The FAA replied to the Safety Board that it agreed with the intent of the recommendation. In 1996, the FAA further responded to the Safety Board by citing the promulgation of the commuter rule, which changed the regulatory basis of scheduled passenger operations using aircraft with 10 or more passenger seats from 14 CFR Part 135 to Part 121. Based on this action and the existing Part 121 restrictions on VFR operations, on July 15, 1996, Safety Recommendation A-90-137 was classified "Closed—Acceptable Action."

³ See *Aloha IslandAir, Inc., Flight 1712, DeHavilland Twin Otter, DHC-6-300, N707PV, Halawa Point, Molokai, Hawaii, October 28, 1989*. Aviation Accident Report NTSB/AAR-90/05. Washington, DC.

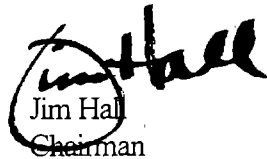
Although the FAA's action in response to Safety Recommendation A-90-137 has continued to be effective for operations that use 10-seat and larger aircraft, the St. Thomas accident indicates that VFR operations at night continue to pose a hazard to passengers on scheduled flights that use smaller aircraft. Passengers on these flights should be provided the additional safety benefits that result from using IFR procedures and receiving radar traffic and terrain advisories when their flights are operated at night. These benefits include the restriction of operations to published routes or areas where ATC can provide radar vectors and the MSAW system. Most 14 CFR Part 135 scheduled passenger flights should be able to operate under IFR. However, the Safety Board recognizes that some of these flights may not be able to operate under IFR because of the lack of necessary ground navigational aids and instrument approach procedures or the characteristics of the airplanes being used. (Commercial, passenger-carrying operations are not permitted to fly under IFR in many single-engine airplane types.)

Therefore, the National Transportation Safety Board makes the following recommendation to the Federal Aviation Administration:

Require all 14 Code of Federal Regulations Part 135 scheduled passenger flights that are operated at night to be conducted under instrument flight rules, with any exceptions to be provided in air carrier operations specifications on a route-by-route basis when instrument flight rules operations are found to be unfeasible. (A-98-87)

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

By:


Jim Hall
Chairman



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: October 7, 1998

In reply refer to: A-98-111

Honorable Jane F. Garvey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On February 20, 1997, at 0645 central standard time, a Douglas DC-9-15, N93S, operated as Northwest Airlines (NWA) flight 219 under Title 14 Code of Federal Regulations Part 121, from Minneapolis, Minnesota, to Kansas City, Missouri, experienced an in-flight electrical fire, which filled the cockpit with smoke and fumes. The crew donned their oxygen masks and turned off both generators and the battery switch. They flew with a flashlight for 1 minute and then turned the emergency power switch on after the flames had extinguished themselves. The flightcrew declared an emergency, and the flight was diverted to the Des Moines International Airport, Des Moines, Iowa, and landed without further incident. None of the 4 crewmembers or the 32 passengers on board were injured, and the airplane sustained minor damage.

Examination of the airplane indicated that the electrical fire originated within the power distribution system's cross-tie relay, Westinghouse¹ part number (P/N) 914F567-4. The cross-tie relay allows either the left or right three-phase² alternating current (AC) generator to supply electrical power to all AC buses. Seven relays of this type are used in each DC-9 series airplane to provide electrical power source switching, including the cross-tie relay, left and right (L&R) generator relays (GR), L&R auxiliary power relays (APR), and L&R external power relays (EPR). These seven relays are mounted in the electrical power center (EPC) distribution panel in the cockpit.

Examination of the cross-tie relay from N93S revealed that the failure resulted from a phase-to-phase short,³ which was caused by the presence of main contact wear products

¹ Now Sundstrand Corporation.

² Comprises three single-phase windings that each produce a continuously alternating voltage/current.

³ Low resistance connection between two conductors normally insulated from each other (i.e. short circuit).

(debris) throughout the contact housing (arc box). NWA's records indicated that the relay had 35,160 hours total time and 7,775 hours since the last overhaul.

An examination of Douglas Aircraft Company⁴ (DAC) incident summary reports indicated that on November 5, 1974, a DC-9-31 experienced a similar cross-tie failure, during an approach for landing, in which smoke and sparks emitting from the EPC panel caused an emergency evacuation after landing. On June 5, 1975, another cross-tie relay caught fire in a DC-9-15 during taxi for takeoff. The smoke reportedly was so thick aft of the cockpit that the flight attendant was unable to locate the cockpit call button; she had to go to the rear of the aircraft to use the call button to inform the crew about the fire. Westinghouse concluded that the most likely cause of these failures was a phase-to-phase short within the relay.

As a result of this finding, on July 9, 1975, DAC notified all operators⁵ that all cross-tie relays with more than 7,000 hours service should be removed within 3,000 hours to be cleaned and inspected per Westinghouse Overhaul Manual 24-20-46, dated May 1, 1975. On July 1, 1975, Westinghouse issued Service Bulletin (SB) 75-701 to incorporate a more flame-resistant Lexan relay cover and improve the relay's internal wiring clearances. In March 1976, Westinghouse issued SB 75-703 to add a gasket seal to each of the interphase barriers of the contact housing and change the power relay assembly P/N from 914F567-3 to 914F567-4. The P/N 914F567-4 relay incorporates the changes recommended in SBs 75-701 and 75-703. Westinghouse informed operators that the reason for the change was to prevent phase-to-phase shorts resulting from the migration of main contact wear products through the contact housing interphase barriers. This modification was specifically recommended for all cross-tie relays. In June 1977, Westinghouse revised SB 75-703 to recommend, for the advantages of interchangeability, that this modification also be accomplished on all GRs, APRs, and EPRs.

On May 5, 1976, DAC issued All Operators Letter (AOL) 9-977 to recommend that all model DC-9, C-9A, and C-9B aircraft cross-tie relays be modified, in accordance with the two Westinghouse SBs, within 6,000 flight hours. The letter also informed operators that beginning with aircraft fuselage No. 850, subsequent production would have the improved power relay (P/N 914F567-4) installed in all seven relay positions.

On June 25, 1985, McDonnell Douglas⁶ (MD) issued AOL 9-1120A to advise operators that Westinghouse had developed an improved hybrid power relay, P/N 9008D09, which incorporated a deep cavity arc box and utilized magnetically held contacts, in lieu of the mechanically latched type formerly used by DAC. The design increased the recommended time between overhaul (TBO) to 12,000 flight hours, compared to the recommended TBO of 7,000 flight hours for the P/N 914F567-3 and -4 relays. On November 12, 1991, MD issued AOL 9-1120B to clarify the interchangeability between the old and new relay P/Ns. The operators were advised that the new relay, P/N 9008D09-X, was interchangeable with relay P/N 914F567-X, in all seven power relay positions on all DC-9 and MD-80 aircraft. The

⁴ Now Boeing, Douglas Products Division.

⁵ Telex DC-9-COM-31/HRG, dated July 9, 1975.

⁶ Now Boeing, Douglas Products Division.

letter also informed operators that the improved power relays would be installed at all seven relay positions during production for MD-80 aircraft, beginning with fuselage No. 909, and for all other DC-9 aircraft, beginning with fuselage No. 930.

A review of FAA service difficulty report (SDR) data for the period between January 1, 1974, and June 1, 1998, for Westinghouse relay P/Ns 914F567-3 and 914F567-4, indicated 21 reported failures. Numerous failures of the relay resulted in electrical power loss, smoke, and unscheduled landings. Many of the failures occurred in relays installed in positions other than the cross-tie location. The SDR data further revealed that several of the -3 and -4 relays had accumulated more than 7,000 flight hours at the time of failure, thereby exceeding the recommended TBO of 7,000 flight hours specified for these relays. One SDR, submitted in 1988, revealed that the operator had continued to utilize the P/N 914F567-3 relay in the cross-tie position subsequent to the 1976 issuance of DAC AOL 9-977.


Based on the February 20, 1997, NWA incident and the continued reports of AC power relay failures, the Safety Board is concerned about the ongoing potential for an electrical fire in the DC-9 series aircraft. This potential can be reduced by the modification of all existing P/N 914F567-3 relays to the -4 configuration and overhaul of the relays every 7,000 flight hours, before contaminants build to a level that will cause shorting between the main contacts of the power relay, or by their replacement with P/N 9008D09 relays. Therefore, the Safety Board believes that the FAA should issue an airworthiness directive to require that DC-9 operators modify all existing Westinghouse P/N 914F567-3 AC power relays (i.e. cross-tie relays, GRs, APRs, and EPRs) to the -4 configuration, in accordance with DAC AOL 9-977, dated May 5, 1976, and overhaul the relays every 7,000 flight hours thereafter or replace these relays with the improved power relay, P/N 9008D09.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Issue an airworthiness directive to require that DC-9 operators modify all existing Westinghouse part number (P/N) 914F567-3 alternating current power relays (i.e. cross-tie relays, generator relays, auxiliary power relays, and external power relays) to the -4 configuration, in accordance with Douglas Aircraft Company All Operators Letter 9-977, dated May 5, 1976, and overhaul the relays every 7,000 flight hours thereafter or replace these relays with the improved power relay, P/N 9008D09. (A-98-111)

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

By:


Jim Hall
Chairman



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: October 26, 1998

In reply refer to: A-98-113 through -118

Honorable Jane F. Garvey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On June 18, 1998, a Swearingen SA226-TC Metroliner II airplane,¹ Canadian registry C-GQAL, operated by PropAir, Inc., crashed after the left wing separated during an attempted emergency landing at Mirabel Airport, Montreal, Quebec, Canada. The flight was operating as a charter from Montreal to Peterborough, Ontario, Canada. The airplane had departed from Montreal's Dorval Airport and was climbing through 12,500 feet when the flightcrew reported a loss of hydraulic pressure and a fire on the left side of the airplane. The pilot then shut down the left engine and declared an emergency. The flightcrew lost control of the airplane at low altitude during the final approach for landing. The airplane was destroyed, and the two flightcrew members and all nine passengers were killed.

The National Transportation Safety Board is participating in the Transportation Safety Board (TSB) of Canada's ongoing investigation under the provisions of Annex 13 to the Convention on International Civil Aviation. On the basis of the preliminary findings of the investigation, the Safety Board has concluded that the Federal Aviation Administration (FAA) should address several safety issues.

The airplane involved in the Montreal accident was equipped with B.F. Goodrich part number (P/N) 2-1203 wheel brake assemblies (see figure 1).² The left wheel well included the

¹ Swearingen Aviation Corporation was the original manufacturer of SA226 and SA227 series airplanes. Fairchild Aircraft, Inc., subsequently acquired Swearingen and continued the production of these airplanes.

² The B.F. Goodrich P/N 2-1203 series brake assembly is a floating-type, single-disk assembly. The steel disk has smooth sides, expansion slots, and tangs around the outer diameter. The tangs are keyed into the wheel so that both rotate together. The disk floats in and out of the wheel to prevent binding during brake application. The cast-aluminum alloy housing, which is bolted to the landing gear strut, has six cylinders, aluminum alloy pistons, and O-rings to prevent leakage. Each piston is protected from the brake pad by an asbestos piston insulator to minimize heat transfer from the disk to the piston. During brake application, hydraulic fluid is forced into the cylinder, and the piston pushes against the insulator, movable brake pad, disk, and opposing brake pad and torque plate to clamp the rotating disk. The airplane involved in the Montreal accident had the original design P/N 2-1203 wheel brake assembly. Subsequent P/N 2-1203 brake assemblies have suffixes of -1 through -4.

hydraulic power pack, a main landing gear (MLG) assembly, aluminum fuel and hydraulic lines and fittings, an overheat sensor, and a rubber fuel crossover line. The overheat sensor illuminates the L WING OVHT (left wing overheat) warning light on the pilot's annunciator panel when temperatures in the wheel well reach 350°F.³ Although the heavier Fairchild/Swearingen model SA227 airplanes (and other commuter and corporate airplanes of the approximate weight) incorporate in the MLG wheels fuse plugs that melt when hot, causing a gradual release of nitrogen pressure and preventing a tire burst, the SA226 does not incorporate such fuse plugs.

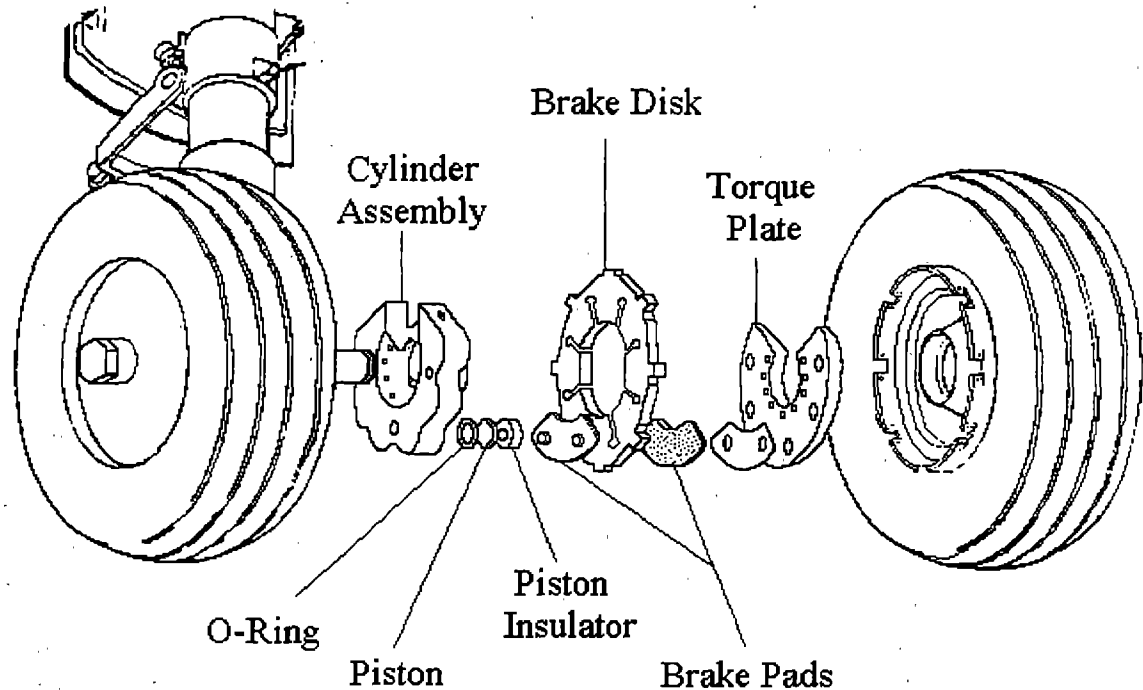


Figure 1. B.F. Goodrich 2-1203 Disk Brake Assembly

The preliminary results of the investigation revealed that, during the takeoff roll, the flightcrew applied the right rudder because the airplane was apparently veering toward the left side of the runway. Approximately 13 minutes after takeoff, the flightcrew noted a loss of hydraulic pressure and the illumination of multiple warning lights, including the left wing overheat warning light. Meanwhile, a passenger reported that the left engine was on fire. The captain later reported that the fire was extinguished and that the back of the engine appeared to have exploded. However, while executing the instrument approach, approximately 1 minute before impact, the flightcrew reported that the fire had resumed. The flightcrew manually extended the landing gear after descending through 1,000 feet, shortly before the left wing failed.

Examination of the wreckage at TSB's facility in Ottawa revealed extensive fire damage to the left MLG wheel well, overheated left MLG brake assemblies, burned tires, melted aluminum

³ A similar sensor is installed in the right wheel well.

hydraulic and fuel lines and fittings, and a burned rubber fuel crossover line. Witness marks on the inside of the brake cylinders and on the outside of the piston insulators indicated that the pistons were cocked within their respective cylinders. Most of the brake pads were worn unevenly, exposing the base metal. The piston insulators and brake disks were also worn unevenly; however, the wear on the disks was within the minimum thickness requirements specified in the airplane's maintenance manual. Although the airplane's main and brake hydraulic systems had a placard specifying MIL-H-83282, analysis of the fluid in both systems revealed a mixture of MIL-H-83282 and MIL-H-5606 hydraulic fluids.⁴ The mixed fluids had a flash point of approximately 237°F.

The investigation thus far indicates that the flightcrew applied the right rudder during the takeoff roll probably to compensate for a dragging left wheel brake and then raised the landing gear, with overheated brakes, into the left wheel well. Although the precise cause of the wheel well fire has not yet been determined, the investigative findings indicate that the ensuing fire in the left wheel well may have been caused by either (1) leaking low flash point brake system hydraulic fluid from a brake cylinder or (2) leaking fluid from damaged lines in the wheel well from an exploding tire coming in contact with and being ignited by the hot brake disk. The fire became hotter as additional flammable liquids from the brake, hydraulic, and fuel systems were introduced. This fire likely led to the wing failure. Leaking brake cylinders could have been caused by the cocked pistons, which appear to have resulted from the combined effects of excessive and uneven brake pad wear, uneven disk wear, and unevenly worn piston insulators on the outboard brake.

Use of Lower Flash Point Hydraulic Fluid

The accident and incident history of Fairchild/Swearingen SA226 and SA227 series airplanes revealed two previous cockpit fire accidents that involved the lower flash point MIL-H-5606 hydraulic fluid. On October 15, 1982, a Sun Aire Swearingen SA226-TC Metroliner II caught fire in Palm Springs, California, when an electrical arc from the copilot's panel light rheostat ignited wires, contaminated with hydraulic fluid from the right brake line, underneath the side panel. Additionally, on August 27, 1983, a Scheduled Skyways Swearingen SA226-TC Metroliner II caught fire in Hot Springs, Arkansas, when an electrical arc ignited wires, contaminated with hydraulic fluid, underneath the instrument panel.⁵

After the investigations of these two accidents, the Safety Board issued Safety Recommendation A-83-59, which asked the FAA to require operators to comply with Fairchild Service Bulletin (SB) 32-018 and use fire-retardant hydraulic fluid. As a result, the FAA issued Airworthiness Directive (AD) 83-19-02 on September 29, 1983,⁶ which required operators of

⁴ According to Air Force Aero Propulsion Laboratory Report AFAPL-TR-85-2057, MIL-H-5606 is a mineral oil product with a flash point of approximately 194°F, and MIL-H-83282 is a synthetic hydrocarbon with a flash point of approximately 390°F. Although the fluids are chemically compatible, mixing MIL-H-83282 with as little as 5 percent of MIL-H-5606 can render the first fluid's fire-retardant feature ineffective.

⁵ For more detailed information on these two accidents, see Briefs of Accident DCA83AA037 and LAX83FA002 (enclosed).

⁶ A similar directive was issued by the Canadian government's aviation regulatory authority, Transport Canada.

certain Swearingen SA226 series airplanes, including the airplane involved in the accident in Montreal, to drain and purge the main hydraulic and brake system reservoirs and refill them with MIL-H-83282 hydraulic fluid.⁷ The AD also required that operators change the placards on both reservoirs to specify that only MIL-H-83282 fluid be used. On February 21, 1984, the Safety Board classified this recommendation "Closed—Acceptable Action."

Although AD 83-19-02 and Fairchild's airplane maintenance manual required the use of MIL-H-83282 hydraulic fluid in the main and brake hydraulic systems in Swearingen SA226 and SA227 series airplanes, respectively, the Safety Board is concerned that the use of the lower flash point MIL-H-5606 or the mixing of MIL-H-5606 with MIL-H-83282 may be occurring. Therefore, the Safety Board believes that the FAA should require principal maintenance inspectors to notify operators of Fairchild/Swearingen SA226 and SA227 series airplanes of the Montreal accident and the requirement to use only the higher flash point MIL-H-83282 hydraulic fluid in all B.F. Goodrich P/N 2-1203 series brake systems.

Brake Assembly Overheating

The accident and incident history of Fairchild/Swearingen SA226 and SA227 series airplanes also revealed two previous wheel well fire accidents. On July 27, 1988, a Peninsula Airways Fairchild SA227-AC Metroliner III experienced a loss of hydraulic pressure, wheel well and wing overheat indications, exploded tires, and substantial fire damage in the left wheel well.⁸ The flightcrew made a successful emergency landing at Anchorage International Airport in Alaska. Additionally, on February 10, 1990, a Perimeter Airlines Swearingen SA226-TC Metroliner II similarly experienced a loss of hydraulic pressure, wheel well and wing overheat indications, exploded tires, and substantial fire damage to the left wheel well. The flightcrew shut down the left engine and made a successful emergency landing at Winnipeg International Airport in Canada.⁹

As a result of its investigation into the Anchorage incident, the Safety Board issued Safety Recommendation A-89-101, asking the FAA to conduct a directed safety investigation of the Fairchild SA226 and SA227 wheel braking systems that utilize the B.F. Goodrich P/N 2-1203-3 wheel brake assembly to (1) determine the potential for brake lockups or overheating as a result of piston insulator cocking and (2) evaluate the current wear limits for proper brake operation at the maximum wear allowed. The FAA reviewed the 5-year history of service difficulty reports regarding B.F. Goodrich brake malfunctions and discovered that 75 reports, including 9 incidents of MLG brake or wheel well fires, had been filed. On October 26, 1989, B.F. Goodrich issued Service Letter (SL) 1498 to clarify the proper location to take wear measurements for all P/N 2-1203 series brake assemblies and revise the maximum allowable clearance for brake assembly P/N 2-1203-3 to reduce the brake lining wear allowed before required overhaul. The FAA issued a special notice to FAA inspectors to alert them that SL 1498 revised the method of determining brake wear and the brake wear limit for P/N 2-1203 brake assemblies, and Fairchild

⁷ The Fairchild/Swearingen SA227 series airplane maintenance manual already specified the use of MIL-H-83282 in the main and brake hydraulic systems.

⁸ For more detailed information, see Brief of Accident ANC88FA100 (enclosed).

⁹ For more detailed information, see Aviation Occurrence Report synopsis A90C0024 (enclosed).

revised its maintenance manual accordingly. On June 18, 1990, the Safety Board classified this recommendation "Closed—Acceptable Action."

Also, the Safety Board issued Safety Recommendation A-89-102, asking the FAA to take appropriate action to prevent brake binding and overheating of B.F. Goodrich P/N 2-1203-3 brake assemblies. On January 16, 1992, the FAA issued AD 92-01-02, which required that operators of SA226 and SA227 airplanes equipped with B.F. Goodrich P/N 2-1203-3 brakes inspect and conduct wear measurements in accordance with SL 1498 and that operators of certain SA226 and SA227 airplanes modify the parking brake system in accordance with Fairchild SBs 227-32-017 and 226-32-049.¹⁰ On March 24, 1992, the Safety Board classified this recommendation "Closed—Acceptable Action."

The wear measurement techniques specified in the component maintenance manual, SL 1498, and AD 92-01-02 were intended to measure the amount of brake wear. However, the techniques were not designed to measure or detect the degree of uneven wear, which could lead to cocked pistons and result in dragging brakes, hydraulic fluid leakage, and wheel well fires. Therefore, the Safety Board believes that the FAA should require B.F. Goodrich to develop and implement a process for identifying and eliminating excessive uneven wear on all B.F. Goodrich P/N 2-1203 series wheel brake assemblies used on Fairchild/Swearingen SA226 and SA227 series airplanes.

Need for Improved Emergency Procedures to Address Wheel Well Fires

The SA226-TC airplane flight manual (AFM) states that, after the illumination of a wing overheat warning light, the flightcrew should secure the bleed air from the affected engine and extend the landing gear. The flightcrew involved in the Montreal accident apparently noticed a loss of hydraulic pressure and the left wheel well and wing overheat warning light but did not extend the landing gear until just before impact. In this accident, immediate extension of the landing gear might have prevented failure of the left wing.

The AFM emergency procedure to address the illumination of the wheel well and wing overheat warning light assumes that the cause is an air conditioning duct overheat and does not consider the consequences of a wheel well fire and the loss of hydraulic pressure or other airplane systems. For example, the procedure calls for shutting down the engine on the affected side of the airplane, which would be appropriate for an air conditioning duct overheat or a bleed air leak but unnecessary for a brake fire. Therefore, the Safety Board believes that the FAA should require Fairchild to (1) expand the description of the wing and wheel well overheat annunciator panel warning light in all Fairchild/Swearingen SA226 and SA227 series AFMs to note that a L or R WING OVHT annunciation may indicate a brake or wheel well fire and (2) expand the emergency procedure for a wheel well and wing overheat warning annunciation to address a wheel well fire and the consequences of other airplane system failures as a result of the fire.

¹⁰ The requirement for the parking brake system is not relevant to the issues discussed in this safety recommendation letter.

The Safety Board is also concerned about the vulnerability of the MLG wheel well in all Fairchild/Swearingen SA226 and SA227 series airplanes to the consequences of overheated brakes and wheel well fires. In the Montreal accident, the heat from the wheel well fire consumed the rubber fuel crossover line, melted aluminum fuel and hydraulic system lines and fittings, and allowed flammable fluid to be introduced to the wheel well fire. In addition, the wheel well might have incurred damage from bursting tires. A brake temperature monitoring or overheat detection system could have provided the pilots with an earlier warning of an overheating brake. Also, the introduction of flammable fluids may have been prevented had the airplane been equipped with stainless steel, rather than aluminum, hydraulic and fuel lines; a heat-resistant fuel crossover line; or fuse plugs such as those already installed in the higher gross weight SA227 series airplanes. Therefore, the Safety Board believes that FAA should require the modification of Fairchild/Swearingen SA226 and SA227 series airplanes to (1) include the installation of a brake temperature monitoring or overheat detection system; (2) provide protection to keep tires from exploding; and (3) protect the lines, fittings, and tubing installed in the wheel wells from hazards associated with exploded tires and fire.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Require principal maintenance inspectors to notify operators of Fairchild/Swearingen SA226 and SA227 series airplanes of the Montreal accident and the requirement to use only the higher flash point MIL-H-83282 hydraulic fluid in all B.F. Goodrich part number 2-1203 series brake systems. (A-98-113)

Require B.F. Goodrich to develop and implement a process for identifying and eliminating excessive uneven wear on all B.F. Goodrich part number 2-1203 series wheel brake assemblies used on Fairchild/Swearingen SA226 and SA227 series airplanes. (A-98-114)

Require Fairchild to (1) expand the description of the wing and wheel well overheat annunciator panel warning light in all Fairchild/Swearingen SA226 and SA227 series airplane flight manuals to note that a L or R WING OVHT annunciation may indicate a brake or wheel well fire and (2) expand the emergency procedure for a wheel well and wing overheat warning annunciation to address a wheel well fire and the consequences of other airplane system failures as a result of the fire. (A-98-115)

Require the modification of Fairchild/Swearingen SA226 and SA227 series airplanes to

(1) include the installation of a brake temperature monitoring or overheat detection system; (A-98-116)

(2) provide protection to keep tires from exploding; (A-98-117) and

- (3) protect the lines, fittings, and tubing installed in the wheel wells from hazards associated with exploded tires and fire. (A-98-118)

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

A handwritten signature in black ink, appearing to read "Jim Hall", is written over a circular stamp or seal.

By: Jim Hall
Chairman

Enclosures

National Transportation Safety Board
Washington, D.C. 20594

Brief of Accident

LAX83FA002

File No. - 2077 10/15/82

PALM SPRINGS, CA

A/C Reg. No. N63SA

Time (Lcl) - 1957 PDT

-----Basic Information-----

Type Operating Certificate-AIR CARRIER

Commuter air carrier
- Scheduled, Domestic, Passenger
Flight Conducted Under -14 CFR 135
Accident Occurred During -STANDING

Aircraft Damage

Substantial
Fire
ON GROUND

Injuries

Fatal
Crew 0
Pass 0
Serious 0
Minor 0
None 2
15

-----Aircraft Information-----

Make/Model - SWEARINGEN SA-226TC
Landing Gear - Tricycle-retractable
Max Gross Wt - 12500
No. of Seats - 20

Eng Make/Model - GARRETT TPE-331
Number Engines - 2
Engine Type - Turboprop
Rated Power - 840 HP

ELT Installed/Activated - YES/NO
Stall Warning System - YES
Weather Radar - YES

-----Environment/Operations Information-----

Weather Data

Wx Briefing - Company
Method - In person
Completeness - Full
Basic Weather - VMC
Wind Dir/Speed - 290/008 KTS
Visibility - 50.0 SM
Cloud Conditions(1st) - NONE
Cloud Conditions(2nd) - NONE
Obstructions to Vision - None
Precipitation - None
Condition of Light - Night (dark)

Itinerary

Last Departure Point
PALM SPRINGS, CA
Destination
LOS ANGELES, CA

Airport Proximity

On airport
Airport Data
PALM SPRINGS
Runway Ident - N/A
Runway Lth/Wid - N/A
Runway Surface - N/A
Runway Status - N/A

-----Personnel Information-----

Pilot-In-Command

Certificate(s)/Rating(s)
ATP

SE land, ME land

Age - 27

Biennial Flight Review

Current - YES
Months Since - 1
Aircraft Type - SA-226

Medical Certificate - Valid medical-no waivers/limit

Flight Time (Hours)

Total - 5100
Make/Model- 3600
Instrument - 430
Multi-Eng - 4200
Last 24 Hrs - 0
Last 30 Days - 80
Last 90 Days- 250
Rotorcraft - 0

Instrument Rating(s) - Airplane

-----Narrative-----

WHILE AT THE GATE WITH THE PASSENGERS SEATED & THE ENGINES RUNNING, THE COPILOT ATTEMPTED TO TURN UP HIS PANEL LIGHTS WITH THE RHEOSTAT LOCATED ON THE FAR RIGHT FORWARD PORTION OF THE SIDE ELECTRICAL PANEL. AT THAT INSTANT SMOKE BEGAN TO ERUPT AT HIS RIGHT KNEE POSITION. THE PASSENGERS WERE EVACUATED & THE COCKPIT FIRE WAS PUT OUT BY THE GROUND CREW. THE RHEOSTAT WAS FOUND TO BE CONTAMINATED WITH HYDRAULIC FLUID, & HEAVY ARCING WAS FOUND ON THE RHEOSTAT AT THE FULL HIGH POSITION. THREE HYDRAULIC LINES WERE FOUND TO BE BURNED IN HALF FORWARD & UNDER THE CIRCUIT BREAKER PANEL ACCESS DOOR. EXAMINATION OF THE HYDRAULIC BRAKE LINE REVEALED STRESS CRACKS DUE TO CHEMICAL CONTAMINATION OR FATIGUE, PERMITTING BRAKE FLUID TO ESCAPE INTO THE SURROUNDING AREA. THE BRAKE FLUID WAS IGNITED BY THE ARCING COPILOT'S RHEOSTAT, & THE FIRE REACHED AN OXYGEN LINE WITHIN SECONDS CAUSING A BLOW-OUT HOLE THRU THE FUSELAGE.

Occurrence #1 FIRE/EXPLOSION
Phase of Operation STANDING - ENGINE(S) OPERATING

Finding(s)

1. LIGHT CONDITION - DARK NIGHT
 2. INSTRUMENT LIGHTS - CONTAMINATION
 3. INSTRUMENT LIGHTS - ARCING
 4. HYDRAULIC SYSTEM, LINE - CONTAMINATION
 5. HYDRAULIC SYSTEM, LINE - DUMPED
 6. HYDRAULIC SYSTEM, LINE - FAILURE, PARTIAL
 7. HYDRAULIC SYSTEM, LINE - LEAK
 8. HYDRAULIC SYSTEM, LINE - BURNED
 9. FUSELAGE, INSTRUMENT/ELECTRICAL PANEL - BURNED
 10. OXYGEN SYSTEM, CREW - EXPLODED
-

-----Probable Cause-----

The National Transportation Safety Board determines that the Probable Cause(s) of this accident is/are finding(s) 2, 3, 4, 5, 6, 7, 8, 9, 10

National Transportation Safety Board
Washington, D.C. 20594

Brief of Accident

DC A83AA037	FILE NO. 2216 08/27/83	HOT SPRINGS, AR	AIRCRAFT REG. NO. N503SS	TIME (LOCAL) - 20:03 CDT
MAKE/MODEL	- SWEARINGEN SA226TC		FATAL	SERIOUS
ENGINE MAKE/MODEL	- AIRESEARCH TPE-331		CREW 0	0
AIRCRAFT DAMAGE	- Substantial		PASS 0	0
NUMBER OF ENGINES	- 2			MINOR/NONE
OPERATING CERTIFICATES				
NAME OF CARRIER	- Commuter air carrier			
TYPE OF FLIGHT OPERATION	- SCHEDULED SKYWAYS INC.			
	- Scheduled			
	- Domestic			
	- Passenger			

REGULATION FLIGHT CONDUCTED UNDER - 14 CFR 135

LAST DEPARTURE POINT DESTINATION	- DALLAS, TX - LITTLE ROCK, AR	CONDITION OF LIGHT - Dusk	WEATHER INFO SOURCE - Unk/Nr
AIRPORT PROXIMITY	- On airport	BASIC WEATHER	- Visual (VMC)
AIRPORT NAME	- MEMORIAL FIELD	LOWEST CEILING	- None
RUNWAY IDENTIFICATION	- 05	VISIBILITY	- 0008.000 SM
RUNWAY LENGTH/WIDTH (Feet)	- 6595/ 150	WIND DIR/SPEED	- Calm
RUNWAY SURFACE	- Asphalt	TEMPERATURE (F)	- 89
RUNWAY SURFACE CONDITION	- Dry	OBSTR TO VISION	- None
		PRECIPITATION	- None

PILOT-IN-COMMAND AGE - 33 FLIGHT TIME (Hours)

CERTIFICATES/RATINGS

Commercial, Airline transport
Single-engine land, Multiengine land

INSTRUMENT RATINGS

Airplane

TOTAL ALL AIRCRAFT - 05120
LAST 90 DAYS - 00180
TOTAL MAKE/MODEL - 03000
TOTAL INSTRUMENT TIME - 690

TURNING ONTO THE RWY THE COPLT OBSERVED A FLASH BEHIND HIS INST PANEL. HE THEN RECEIVED AN ELECT SHOCK TO HIS RIGHT ARM FROM THE RIGHT CONSOLE. A FIRE THEN ERUPTED AT THE LOWER RIGHT HAND CORNER OF HIS INST PANEL. THE CREW & PAX EVACUATED THE ACFT. THE INTERIOR OF THE ACFT WAS CONSUMED BY FIRE AS WELL AS MOST OF THE UPPER HALF OF THE FUSELAGE. EXAM OF THE RIGHT SIDE WIRE BUNDLE REVEALED NUMEROUS INDICATIONS OF ARCING BETWEEN WIRES & FROM WIRES TO GROUND. ONE WIRE WAS ARCED AT A POINT IN LINE WITH A PLASTIC OXYGEN LINE. THERE WAS ALSO AN OILY RESIDUE INSIDE THE WIRE BUNDLE. A SMALL SECTION OF THE RIGHT BRAKE PRESSURE LINE EXHIBITED SIGNS OF ELECT ARCING. THE HYDRAULIC SYST PRESS GAGE COPPER LINE ALSO SHOWED SIGNS OF ARCING. THE PLASTIC OXYGEN LINES FROM THE THE COCKPIT SIDE OF THE FORWARD PRESSURE BULKHEAD TO THE COCKPIT OUTLETS HAD BEEN CONSUMED BY FIRE & THE OXYGEN SUPPLY WAS DEPLETED.

Occurrence# 1	FIRE
Phase of Operation	TAXI - TO TAKEOFF

Findings

1. - FUSELAGE, INSTRUMENT/ELECTRICAL PANEL - SHORTED
2. - FUSELAGE, INSTRUMENT/ELECTRICAL PANEL - ARCING
3. - ELECTRICAL SYSTEM, ELECTRIC WIRING - ARCING
4. - ELECTRICAL SYSTEM, ELECTRIC WIRING - CONTAMINATION
5. - ELECTRICAL SYSTEM, ELECTRIC WIRING - FIRE
6. - OXYGEN SYSTEM, CREW - BURST
7. - FUSELAGE, INSTRUMENT/ELECTRICAL PANEL - FIRE
8. - FUSELAGE - FIRE

---Probable Cause---

CAUSES	1	2	3	4	5	6	7	8
FACTORS								

National Transportation Safety Board
Washington, D.C. 20594

Brief of Accident

Adopted 09/19/1989

ANC88FA100
FILE NO. 1006 07/27/88 ANCHORAGE, AK IRCRAFT REG. NO. N482SA TIME (LOCAL) - 18:17 ADT

MAKE/MODEL	- FAIRCHILD SA227-AT	FATAL	SERIOUS	MINOR/NONE
ENGINE MAKE/MODEL	- GARRETT TPE-331-1146	CREW 0	0	2
AIRCRAFT DAMAGE	- Substantial	PASS 0	0	6
NUMBER OF ENGINES	- 2			

OPERATING CERTIFICATES

- Commuter air carrier
- On-demand air taxi

NAME OF CARRIER

TYPE OF FLIGHT OPERATION

- PENINSULA AIRWAYS
- Scheduled
- Domestic
- Passenger/cargo

REGULATION FLIGHT CONDUCTED UNDER - 14 CFR 135

LAST DEPARTURE POINT DESTINATION	- Same as Accident - DILLINGHAM, AK	CONDITION OF LIGHT - Daylight	
AIRPORT PROXIMITY	- On airport	WEATHER INFO SOURCE	- Weather observation facility
AIRPORT NAME	- ANCHORAGE INT'L	BASIC WEATHER	- Visual (VMC)
RUNWAY IDENTIFICATION	- 14	LOWEST CEILING	- None
RUNWAY LENGTH/WIDTH (Feet)	- 10496/ 150	VISIBILT	- 0060.000 SM
RUNWAY SURFACE	- Asphalt	WIND DIR/SPEED	- 170 /016 KTS
RUNWAY SURFACE CONDITION	- Dry	TEMPERATURE (F)	- 63
		OBSTR TO VISION	- None
		PRECIPITATION	- None

PILOT-IN-COMMAND	AGE - 39	FLIGHT TIME (Hours)
CERTIFICATES/RATINGS		
Airline transport		TOTAL ALL AIRCRAFT - 14800
Single-engine land, Multiengine land, Single-engine sea		LAST 90 DAYS - 293
		TOTAL MAKE/MODEL - 2650

INSTRUMENT RATINGS
Airplane

TOTAL INSTRUMENT TIME - 2841

DURING THE TAXI TO THE RUNWAY, THE FLIGHT CREW NOTED A VIBRATION IN THE AIRPLANE AND STOPPED TO CHECK THE TIRES, THINKING THAT THEY WERE UNDERINFLATED. NO OBVIOUS PROBLEM WAS SEEN, AND THEY ELECTED TO TAKEOFF. SHORTLY AFTER TAKEOFF, A FIRE ERUPTED IN THE LEFT MAIN GEAR WHEELWELL. THE PILOT RETURNED TO THE AIRPORT AND LANDED SAFELY. HOWEVER, THE AIRPLANE SUSTAINED EXTENSIVE DAMAGE TO THE LEFT WING AND AILERON CONTROL SYSTEM. EXAMINATION OF THE BRAKES REVEALED A COCKED THERMAL INSULATOR IN THE PISTON BORE. THERE WAS EVIDENCE THAT THE BRAKES WERE WORN, HAD BEEN DRAGGING, THEN OVERHEATED; AND THAT THE TIRES HAD EXPLODED PRIOR TO THE FIRE. THE FIRE DAMAGE INDICATED THAT THE FIRE HAD STARTED NEAR THE BRAKES. AN ALUMINUM FITTING WAS USED AS PART OF THE HYDRAULIC BRAKE SYSTEM ON THE STEEL BRAKE HOUSING. THE EXAM INDICATED THAT THE FITTING HAD BEEN INSTALLED BUT COULD NOT BE FOUND AFTER THE FIRE. THE CREW SAID THAT THEY DELAYED LOWERING THE GEAR, IN CONTRADICTION TO THE CHECKLIST REQUIREMENT WHEN THE WHEELWELL AND WING OVERHEAT LIGHT IS ON.

Occurrence# 1 AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation TAXI - TO TAKEOFF

Findings

1. - LANDING GEAR, NORMAL BRAKE SYSTEM - BINDING (MECHANICAL)
2. - ACFT/EQUIP, INADEQUATE AIRCRAFT COMPONENT - MANUFACTURER
3. - PROPER ASSISTANCE - NOT OBTAINED - PILOT-IN-COMMAND

Occurrence# 2 FIRE
Phase of Operation CLIMB

Findings

4. - LANDING GEAR, NORMAL BRAKE SYSTEM - OVERTEMPERATURE
5. - HYDRAULIC SYSTEM, FITTING - MELTED
6. - EMERGENCY PROCEDURE - NOT FOLLOWED - PILOT-IN-COMMAND

---Probable Cause---

CAUSES 1 2 3 4 5
FACTORS 6

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

AVIATION OCCURRENCE REPORT

**PERIMETER AIRLINES
SWEARINGEN SA226TC METRO II C-FGEP
WINNIPEG, MANITOBA
10 FEBRUARY 1990**

REPORT NUMBER A90C0024

SYNOPSIS

The twin-engine turboprop aircraft, with two pilots and 11 passengers on board, departed Winnipeg International Airport on a regular scheduled flight to Island Lake, Manitoba. About 10 minutes north, while the aircraft was climbing to cruise altitude, the hydraulic system pressure started to fall. The pilot advised Winnipeg air traffic control that they were returning to the airport. The left main landing gear indicator lights then came on, showing both in-transit and down and locked. The pilots heard two loud bangs from the left side of the aircraft, and the captain feathered the left engine. On final approach, a manual landing gear extension was completed, and the tower controller advised the pilot that the left landing gear was not visible, and that the left engine was on fire. The pilot carried out an emergency landing, and all the occupants evacuated the aircraft safely.

The Transportation Safety Board of Canada determined that an overheated left inner brake ignited the left main landing gear tires, and that the fire was fuelled by a leaking fuel pressure line in the left wheel well.



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: October 16, 1998

In reply refer to: M-98-123

Mr. James Bean
President
Bean Horizon Corporation
619 Engineers Road
Post Office Box 237
Belle Chase, Louisiana 70037

About 4:50 a.m. central daylight time on October 23, 1996, in Tiger Pass, Louisiana,¹ the crew of the Bean Horizon Corporation dredge *Dave Blackburn* dropped a stern spud² into the bottom of the channel in preparation for continued dredging operations. The spud struck and ruptured a 12-inch-diameter submerged natural gas steel pipeline owned by Tennessee Gas Pipeline Company.³ The pressurized (about 930 psig) natural gas released from the pipeline enveloped the stern of the dredge and an accompanying tug, the *G.C. Linsmier*. Within seconds of reaching the surface, the natural gas ignited.⁴ The resulting fire destroyed the dredge and the tug. All 28 crewmembers from the dredge and tug escaped into the water or onto nearby vessels.⁵

Bean had established a safety program for its vessels that included initial, crew-change-out, and monthly abandon ship and man overboard drills, and weekly all-hands safety meetings. These drills and safety meetings were recorded in the vessels' log books, and written summaries were submitted to the company Loss Control Department. *Dave Blackburn* crewmembers stated that no crew list, crew team assignment, or other crew accounting procedure was in place on the vessel.

¹Tiger Pass is a channel through the Mississippi River delta near Venice, Louisiana, that connects the Mississippi River with the Gulf of Mexico. The channel extends partially into the Gulf of Mexico, where the sides of the pass are defined by rock jetties.

²A spud is a large steel shaft that is dropped into the river bottom to serve as an anchor and a pivot during dredging operations.

³At the time of the accident, Tennessee Gas was a division of Tenneco, Inc. Since the accident, it has become a subsidiary of El Paso Energy Corporation.

⁴The ignition source could not be determined but could have been any of a number of electromechanical devices located on the dredge in the area of the escaping gas.

⁵For more information, read Pipeline Accident Summary Report--*Natural Gas Pipeline Rupture and Fire During Dredging of Tiger Pass, Louisiana, October 23, 1996* (NTSB/PAR-98/01/SUM).

Initially, the U.S. Coast Guard on-scene commander believed that 33 crewmembers were on board the *Dave Blackburn* and the *G.C. Linsmier* at the time of the accident. The Coast Guard incident log indicates that 30 crewmembers were aboard the dredge. The required accident report (CG-2692) submitted by Bean indicated that 28 people were aboard the *Dave Blackburn* at the time of the accident, including 3 crewmembers from the tug *G.C. Linsmier*, who were having breakfast on board the dredge when the pipeline ruptured. No crewmember interviewed after the accident knew with certainty how many personnel had been on board the vessels at the time of the accident. Crewmembers stated that, after the accident, they used an informal survey and quick "head count" to determine that no crewmembers were missing.

A review of Bean's emergency response instructions and the *Dave Blackburn*'s station bill revealed no provision for accurately accounting for the number of persons on board the dredge vessels at any one time.

The Safety Board is concerned that the emergency procedures for Bean's dredging vessels, because they did not require that an accurate and up-to-date count be maintained of all personnel aboard the vessels, were inadequate to ensure the safety of the company's crews and other personnel during an emergency. Without a system to accurately account for all personnel—including crewmembers, contractor personnel, vendors, and visitors—aboard the dredging vessels, the risk is substantial that, in the event of a serious emergency, some individuals may be left behind, perhaps with life-threatening injuries, without anyone knowing of their plight until it is too late.

The Safety Board has investigated several accidents aboard passenger and fishing vessels in which passenger and crew accountability was an issue.⁶ The lack of an accurate personnel list or count has been identified in dredge accidents as well.⁷

In this accident, the speed and extent of the gas release and fire placed all crewmembers aboard the dredging vessels in grave danger. Fortunately, despite the early hour, most crewmembers were awake, alert, and able to respond quickly to the emergency. Given the rapid ignition of the natural gas and the extent of the damage to the vessels, had this accident occurred

⁶For more detailed information, read Marine Accident Reports--*Capsizing of the Charter Passenger Vessel San Mateo in Morro Bay, California, on February 16, 1983* (NTSB/MAR-83/09); *Sinking of the Charter Fishing Boat Joan La Rie III off Manasquan Inlet, New Jersey, on October 24, 1982* (NTSB/MAR-84/02); *Collision of the U.S. Passenger Vessel Yankee and the Liberian Freighter M/V Harbelle Tapper in Rhode Island Sound on July 2, 1983* (NTSB/MAR-84/05); *Sinking of the U.S. Fishing Vessel Amazing Grace 80 Nautical Miles East of Cape Henlopen, Delaware, on November 14, 1984* (NTSB/MAR-85/07); *Collision between the U.S. Passenger Vessel Mississippi Queen and the U.S. Towboat Crimson Glory in the Mississippi River, Near Donaldsonville, Louisiana, on December 12, 1985* (NTSB/MAR-86/09); *Near Capsizing of the Charter Passenger Vessel Merry Jane Near Bodega, California, on February 8, 1986* (NTSB/MAR-86/11); *Capsizing of the Charter Fishing Vessel Fish-N-Fool in the Pacific Ocean Near Roca Ben Baja California Norte, Mexico, on February 5, 1987* (NTSB/MAR-87/11); and *Safety Study--Passenger Vessels Operating from U.S. Ports, 1989* (NTSB/SS-89/01).

⁷The following accidents, although not investigated by the Safety Board, highlight the confusion that can occur when rescue authorities cannot document the number of persons on board a vessel: the United Kingdom Marine Accident Investigation Branch's June 5, 1990, report of the Collision between the passenger launch *Marchioness* and MV *Bowbelle*, with loss of life on the Thames River on August 20, 1989; and the Hong Kong Marine Department's report of inquiry into the circumstances surrounding the capsizing of the Hong Kong registered training suction hopper dredger *Maas* in the approaches to Nan-sha Wan off the island of Dongao Dao on August 1993.

while most of the crew was sleeping, numerous serious injuries or fatalities may have occurred. The Safety Board concluded that, in even a slightly more serious accident, Bean's emergency procedures, because they did not require that a precise count be kept of the number of personnel on board the company's vessels at all times, would have been inadequate to account for and facilitate the rescue of missing crewmembers, increasing their risk of serious injury or death.

The National Transportation Safety Board therefore makes the following safety recommendation to Bean Horizon Corporation:

Amend your emergency response procedures to require that an accurate count of all persons aboard your vessels be maintained at all times by someone in authority on the vessel and be accessible to the vessel operating department on shore so that the number will be readily available to emergency responders in the event of an on-board emergency. (M-98-123)

Also, the Safety Board issued Safety Recommendations P-98-25 to the Research and Special Programs Administration; P-98-26 and -27 to Tennessee Gas Pipeline Company; M-98-124 to the Western Dredging Association; P-98-28 to the Interstate Natural Gas Association of America; and P-98-29 to the American Petroleum Institute.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any action taken as a result of its safety recommendations. Therefore, it would appreciate a response from you regarding action taken or contemplated with respect to the recommendation in this letter. Please refer to Safety Recommendation M-98-123 in your reply. If you need additional information, you may call (202) 314-6469.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

By:


Jim Hall
Chairman



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: October 16, 1998

In reply refer to: M-98-124

Mr. Lawrence M. Patella
Executive Director
Western Dredging Association
Post Office Box 5797
Vancouver, Washington 98668-5797

About 4:50 a.m. central daylight time on October 23, 1996, in Tiger Pass, Louisiana,¹ the crew of the Bean Horizon Corporation (Bean) dredge *Dave Blackburn* dropped a stern spud² into the bottom of the channel in preparation for continued dredging operations. The spud struck and ruptured a 12-inch-diameter submerged natural gas steel pipeline owned by Tennessee Gas Pipeline Company (Tennessee Gas).³ The pressurized (about 930 psig) natural gas released from the pipeline enveloped the stern of the dredge and an accompanying tug, the *G.C. Linsmier*. Within seconds of reaching the surface, the natural gas ignited.⁴ The resulting fire destroyed the dredge and the tug. All 28 crewmembers from the dredge and tug escaped into the water or onto nearby vessels.⁵

On September 20, 1996, Bean was awarded a U.S. Army Corps of Engineers contract to dredge portions of Tiger Pass, including areas where several underwater pipelines were located. The Corps of Engineers provided Bean with Corps of Engineers drawings showing the approximate locations of the pipelines. On these drawings, the Tennessee Gas pipeline was shown as crossing Tiger Pass at centerline station 614+20, or 61,420 feet from the point at which Tiger Pass joins the Mississippi River.⁶ A dredging contract provision, with which Bean

¹Tiger Pass is a channel through the Mississippi River delta near Venice, Louisiana, that connects the Mississippi River with the Gulf of Mexico. The channel extends partially into the Gulf of Mexico, where the sides of the pass are defined by rock jetties.

²A spud is a large steel shaft that is dropped into the river bottom to serve as an anchor and a pivot during dredging operations.

³At the time of the accident, Tennessee Gas was a division of Tenneco, Inc. Since the accident, it has become a subsidiary of El Paso Energy Corporation.

⁴The ignition source could not be determined but could have been any of a number of electromechanical devices located on the dredge in the area of the escaping gas.

⁵For more information, read Pipeline Accident Summary Report--*Natural Gas Pipeline Rupture and Fire During Dredging of Tiger Pass, Louisiana, October 23, 1996* (NTSB/PAR-98/01/SUM).

⁶The junction of Tiger Pass and the Mississippi River was used as a zero reference point by the Corps of Engineers for measuring distances downstream along the center of Tiger Pass. Postaccident measurements

complied, required Bean to notify pipeline owners by certified mail at least 7 days before dredging within 500 feet of their pipelines and to verify the pipeline locations.

On September 22, 1996, Bean began dredging about 1,000 feet southwest of the location of the pipeline as shown on the Corps of Engineers drawing. The initial dredging operation was to move toward the Gulf of Mexico and away from the pipeline. On October 17, the crew received weather reports predicting rough weather. The supervisor of the dredging operation decided to move the operation to a more sheltered area to the northeast, near the point where the dredging had begun but still southwest of the pipeline. According to the supervisor, the plan was to begin dredging there and then move toward the northeast, toward the pipeline. Tennessee Gas was notified by phone that the dredge would soon be approaching the pipeline. Bean's project engineer on the dredge said he questioned a Tennessee Gas supervisor several times about the pipeline's exact location and was told that the location of the pipeline was marked by two pilings, one near either side of the pass.⁷

About 2 p.m., on October 19, a Tennessee Gas inspector boarded the dredge and, using information and a sketch provided by her supervisor, established a 100-foot safety zone in the area of the two pilings. In order to avoid damage to the pipeline, dredging in that area was to be done with the suction pumps only, without using the cutting head. Bean's daily quality control reports showed that the pipeline location identified by Tennessee Gas personnel did not match the location shown on the Corps of Engineers drawings.

Dredging, using only the suction pumps, proceeded across the area of Tiger Pass where the pipeline was believed to be located. The dredge's daily quality control report indicated that the ladder struck an object believed to be the pipeline about 15 feet southwest of the site identified by the Tennessee Gas inspector. Dredging then continued to the northeast to within about 130 feet of the actual pipeline location. Then, on October 20, 1996, because of improving weather, the dredging supervisor decided to return the operation to the Gulf of Mexico end of the channel where weather conditions had previously halted work. The Tennessee Gas inspector left before the dredge was moved, with an agreement that the gas company would be notified when the dredge returned to work in the area of the pipeline.

On October 22, after completing its work at the lower end of the pass, the dredge returned, at 9:40 a.m., to an area about 140 feet to the northeast of the area previously identified by Tennessee Gas as the pipeline location. The crew began dredging to the northeast, believing that the operation was outside the safety zone and moving away from the pipeline. In reality, the dredge was moving *toward* the pipeline, which was about 100 feet away. By 9:30 p.m., the cutting head had crossed over the pipeline without incident.

On October 23, at 4:50 a.m., after stopping the dredging to clean the cutting head and reset the swing anchors, the crew dropped a stern spud into the river at about station 615+12 and

determined that the pipeline actually crossed Tiger Pass at station 615+12, or about 92 feet downstream from the Corps of Engineers' approximate location.

⁷These pilings were located at about station 618+10, about 300 feet downstream of the actual pipeline location.

directly into the Tennessee Gas pipeline, rupturing the pipeline and releasing pressurized natural gas.

Bean had established a safety program for its vessels that included initial, crew-change-out, and monthly abandon ship and man overboard drills, and weekly all-hands safety meetings. These drills and safety meetings were recorded in the vessels' log books, and written summaries were submitted to the company Loss Control Department. *Dave Blackburn* crewmembers stated that no crew list, crew team assignment, or other crew accounting procedure was in place on the vessel.

Initially, the U.S. Coast Guard on-scene commander believed that 33 crewmembers were on board the *Dave Blackburn* and the *G.C. Linsmier* at the time of the accident. The Coast Guard incident log indicates that 30 crewmembers were aboard the dredge. The required accident report (CG-2692) submitted by Bean indicated that 28 people were aboard the *Dave Blackburn* at the time of the accident, including 3 crewmembers from the tug *G.C. Linsmier*, who were having breakfast on board the dredge when the pipeline ruptured. No crewmember interviewed after the accident knew with certainty how many personnel had been on board the vessels at the time of the accident. Crewmembers stated that, after the accident, they used an informal survey and quick "head count" to determine that no crewmembers were missing.

A review of Bean's emergency response instructions and the *Dave Blackburn's* station bill revealed no provision for accurately accounting for the number of personnel on board the dredge vessels at any one time.

The Safety Board is concerned that the emergency procedures for Bean's dredging vessels, because they did not require that an accurate and up-to-date count be maintained of all personnel aboard the vessels, were inadequate to ensure the safety of the company's crews and other personnel during an emergency. Without a system to accurately account for all personnel—including crewmembers, contractor personnel, vendors, and visitors—aboard the dredging vessels, the risk is substantial that, in the event of a serious emergency, some individuals may be left behind, perhaps with life-threatening injuries, without anyone knowing of their plight until it is too late.

The Safety Board has investigated several accidents aboard passenger and fishing vessels in which passenger and crew accountability was an issue.⁸ The lack of an accurate personnel list or count has been identified in dredge accidents as well.⁹

⁸For more information, read Marine Accident Reports--*Capsizing of the Charter Passenger Vessel San Mateo in Morro Bay, California, on February 16, 1983* (NTSB/MAR-83/09); *Sinking of the Charter Fishing Boat Joan La Rie III off Manasquan Inlet, New Jersey, on October 24, 1982* (NTSB/MAR-84/02); *Collision of the U.S. Passenger Vessel Yankee and the Liberian Freighter M/V Harbelle Tapper in Rhode Island Sound on July 2, 1983* (NTSB/MAR-84/05); *Sinking of the U.S. Fishing Vessel Amazing Grace 80 Nautical Miles East of Cape Henlopen, Delaware, on November 14, 1984* (NTSB/MAR-85/07); *Collision between the U.S. Passenger Vessel Mississippi Queen and the U.S. Towboat Crimson Glory in the Mississippi River, Near Donaldsonville, Louisiana, on December 12, 1985* (NTSB/MAR-86/09); *Near Capsizing of the Charter Passenger Vessel Merry Jane Near Bodega, California, on February 8, 1986* (NTSB/MAR-86/11); *Capsizing of the Charter Fishing Vessel Fish-N-Fool in the Pacific Ocean Near Roca Ben Baja California Norte, Mexico, on February 5, 1987* (NTSB/MAR-87/11); and *Safety Study--Passenger Vessels Operating from U.S. Ports, 1989* (NTSB/SS-89/01).

In this accident, the speed and extent of the gas release and fire placed all crewmembers aboard the dredging vessels in grave danger. Fortunately, despite the early hour, most crewmembers were awake, alert, and able to respond quickly to the emergency. Given the rapid ignition of the natural gas and the extent of the damage to the vessels, had this accident occurred while most of the crew was sleeping, numerous serious injuries or fatalities may have occurred. The Safety Board concluded that, in even a slightly more serious accident, Bean's emergency procedures, because they did not require that a precise count be kept of the number of personnel on board the company's vessels at all times, would have been inadequate to account for and facilitate the rescue of missing crewmembers, increasing their risk of serious injury or death. The Safety Board has therefore made the following safety recommendation to Bean Horizon Corporation:

Amend your emergency response procedures to require that an accurate count of all persons aboard your vessels be maintained at all times by someone in authority on the vessel and be accessible to the vessel operating department on shore so that the number will be readily available to emergency responders in the event of an on-board emergency. (M-98-123)

Because the Safety Board's concern about emergency procedures for dredging vessels is not limited to this one operator, the Safety Board makes the following safety recommendation to the Western Dredging Association:

Inform your members of the circumstances of the pipeline rupture and fire in Tiger Pass, Louisiana, and urge them to amend their emergency response procedures as necessary to require that an accurate count of all persons aboard their vessels be available at all times. This count should be maintained by someone in authority on the vessel and be accessible to the vessel operating department on shore so that the number will be readily available to emergency responders in the event of an on-board emergency. (M-98-124)

Also, the Safety Board issued Safety Recommendations P-98-25 to the Research and Special Programs Administration; P-98-26 and -27 to Tennessee Gas Pipeline Company; M-98-123 to Bean Horizon Corporation; P-98-28 to the Interstate Natural Gas Association of America; and P-98-29 to the American Petroleum Institute.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any action taken as a result of its safety recommendations. Therefore, it would appreciate a response from you regarding action taken or

⁹The following accidents, although not investigated by the Safety Board, highlight the confusion that can occur when rescue authorities cannot document the number of persons on board a vessel: the United Kingdom Marine Accident Investigation Branch's June 5, 1990, report of the Collision between the passenger launch *Marchioness* and MV *Bowbelle*, with loss of life on the Thames River on August 20, 1989; and the Hong Kong Marine Department's report of inquiry into the circumstances surrounding the capsizing of the Hong Kong registered training suction hopper dredger *Maas* in the approaches to Nan-sha Wan off the island of Dongao Dao on August 1993.

contemplated with respect to the recommendation in this letter. Please refer to Safety Recommendation M-98-124 in your reply. If you need additional information, you may call (202) 314-6469.

Chairman HALL; Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

By:


Jim Hall
Chairman



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: October 20, 1998

In reply refer to: M-98-125 and -126

To Cruise Vessel Owners and Operators
(address list attached)

On July 20, 1998, a fire occurred on board the Liberian-registered passenger vessel *Ecstasy*, operated by Carnival Cruise Lines. The vessel had just departed Port of Miami, Florida, bound for Key West, Florida, with 2,557 passengers and 920 crewmembers aboard. At 1710, the ship's fire alarm system on the bridge sounded, indicating that a manual alarm had been activated in the laundry room. Fire spread through the laundry ventilation system, and flames and large volumes of smoke were seen issuing from the stern of the vessel. The vessel lost propulsion and steering as a result of the fire, which was brought under control and extinguished about 2109. The ship was returned to its berth at Port of Miami at 0220 on July 21. All passengers safely disembarked before 0600. No fatalities occurred; the injured included 14 crewmembers and 6 passengers.

The fire investigated by the National Transportation Safety Board aboard the *Ecstasy* occurred within the ship's laundry ventilation system. The investigation continues, and the Safety Board expects to issue its final report next year. Within the last 2 years, the Safety Board has investigated two other fires aboard foreign-registered passenger ships operating from U.S. ports.¹ The fires on board the Panamanian *Universe Explorer* and the Bahamian *Vistafjord* were in the vicinity of the ships' laundry and involved minor damage; however, the smoke from the fires caused multiple injuries and deaths. The fire aboard the *Ecstasy* resulted in only minor injuries but caused major damage to the vessel. Preliminary property damage is estimated at \$30 million.

During the current investigation of the *Ecstasy* fire, it was determined that lint, which accumulated in the vessel's exhaust ducting and plenums from the laundry, was a fuel source that

¹ Marine Accident Report—*Fire On Board the Panamanian Passenger Ship Universe Explorer in the Lynn Canal Near Juneau, Alaska, July 27, 1996* (NTSB/MAR-98/02); and Marine Accident Brief—*Fire On Board the Bahamian Passenger Ship Vistafjord in the Atlantic Ocean Near Grand Bahama Island, Bahamas, April 6, 1997* (DCA97MM028).

enabled the fire to spread in the ducting. As a result of the fire, the aft mooring station deck received extensive structural damage. Based on observations of similar vessels, lint from the exhaust ducting likely had also accumulated on the aft mooring deck, which was the exit point of the exhaust plenum.

Safety Board investigators arranged with Carnival Cruise Lines to examine the ventilation system, the laundry room, and the aft mooring deck of two of its vessels, the *Imagination* and the *Fantasy*, which are similar to the *Ecstasy*. The *Imagination* was fitted with a different exhaust filter arrangement on the laundry dryers; its main ship ventilation in the laundry was the same as found on the *Ecstasy*. The dryers on the *Imagination* had been fitted with a "centrifugal" filter. The air from the dryers is vented through the lint traps into this filter and then sent out the exhaust vent. The filter removes a large amount of lint; however, it does not completely remove lint from the laundry exhaust, and lint accumulation was evident on the aft mooring deck. After the removal of the louvers on the exhaust plenum on the mooring deck, lint accumulation was noted in the plenum chamber. The filters on the intake ventilation system for the thruster room, located on the mooring deck, were also coated with lint. In addition, lint was noted on stored mooring line on the deck and on the spooled line on the winches. When Safety Board investigators inspected the laundry room on board the *Fantasy*, which has the same mainship ventilation in the laundry as that on the *Ecstasy*, they found several inches of lint in the dryer ventilation ducts and in the plenum chamber.

Since the *Ecstasy* fire and after the Safety Board inspections on the other similar ships, Carnival Cruise Lines has voluntarily instituted an inspection of the laundry ventilation duct and the plenum system on all its vessels.

The Safety Board believes that cruise vessel owners and operators should immediately inspect, within their fleet of ships, the laundry ventilation systems, including ducts, plenums, and exhaust terminuses, for any combustible material, such as lint, and clean the systems, as necessary, to reduce the risk of fire. The Safety Board also believes these owners and operators should institute a program to verify on a continuing basis that the laundry ventilation systems, including ducts and plenums, remain clean and clear of any combustible material that poses a fire hazard on their vessels.

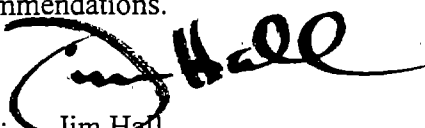
Therefore, the National Transportation Safety Board recommends that the (cruise vessel owner and operator):

Immediately inspect, within your fleet of ships, the laundry ventilation systems, including ducts, plenums, and exhaust terminuses, for any combustible material, such as lint, and clean the systems, as necessary, to reduce the risk of fire.
(Urgent) (M-98-125)

Institute a program to verify on a continuing basis that the laundry ventilation systems, including ducts and plenums, remain clean and clear of any combustible material that poses a fire hazard on your vessels. (M-98-126)

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any actions taken as a result of its safety recommendations and would appreciate a response from you regarding action taken or contemplated with respect to the recommendations in this letter. Please refer to Safety Recommendations M-98-125 and -126 in your reply. If you need additional information, you may call (202) 314-6450.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

By: 
Chairman

**FIRE ABOARD THE LIBERIAN PASSENGER SHIP ECSTASY, MIAMI,
FLORIDA, JULY 20, 1998.**

List of Cruise Vessel Owners and Operators

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National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: October 16, 1998

In reply refer to: P-98-25

Ms. Kelley Coyner
Administrator
Research and Special Programs Administration
400 7th Street, S.W.
Washington, D.C. 20590

About 4:50 a.m. central daylight time on October 23, 1996, in Tiger Pass, Louisiana,¹ the crew of the Bean Horizon Corporation (Bean) dredge *Dave Blackburn* dropped a stern spud² into the bottom of the channel in preparation for continued dredging operations. The spud struck and ruptured a 12-inch-diameter submerged natural gas steel pipeline owned by Tennessee Gas Pipeline Company (Tennessee Gas).³ The pressurized (about 930 psig) natural gas released from the pipeline enveloped the stern of the dredge and an accompanying tug, the *G.C. Linsmier*. Within seconds of reaching the surface, the natural gas ignited.⁴ The resulting fire destroyed the dredge and the tug. All 28 crewmembers from the dredge and tug escaped into the water or onto nearby vessels.⁵

The National Transportation Safety Board determined that the probable cause of this accident was the failure of Tennessee Gas Pipeline Company to accurately locate the company's pipeline across Tiger Pass before that location was dredged. Contributing to the accident was the revocation by the Research and Special Programs Administration of Federal requirements for all pipeline operators to install and maintain markers to identify the locations at which their pipelines cross navigable waterways.

¹Tiger Pass is a channel through the Mississippi River delta near Venice, Louisiana, that connects the Mississippi River with the Gulf of Mexico. The channel extends partially into the Gulf of Mexico, where the sides of the pass are defined by rock jetties.

²A spud is a large steel shaft that is dropped into the river bottom to serve as an anchor and a pivot during dredging operations.

³At the time of the accident, Tennessee Gas was a division of Tenneco, Inc. Since the accident, it has become a subsidiary of El Paso Energy Corporation.

⁴The ignition source could not be determined but could have been any of a number of electromechanical devices located on the dredge in the area of the escaping gas.

⁵For more information, read Pipeline Accident Summary Report--*Natural Gas Pipeline Rupture and Fire During Dredging of Tiger Pass, Louisiana, October 23, 1996* (NTSB/PAR-98/01/SUM).

On September 20, 1996, Bean was awarded a U.S. Army Corps of Engineers contract to dredge portions of Tiger Pass, including areas where several underwater pipelines were located. The Corps of Engineers provided Bean with Corps of Engineers drawings showing the approximate locations of the pipelines. On these drawings, the Tennessee Gas pipeline was shown as crossing Tiger Pass at centerline station 614+20, or 61,420 feet from the point at which Tiger Pass joins the Mississippi River.⁶ A dredging contract provision, with which Bean complied, required Bean to notify pipeline owners by certified mail at least 7 days before dredging within 500 feet of their pipelines and to verify the pipeline locations.

On September 22, 1996, Bean began dredging about 1,000 feet southwest of the location of the pipeline as shown on the Corps of Engineers drawing. The initial dredging operation was to move toward the Gulf of Mexico and away from the pipeline. On October 17, the crew received weather reports predicting rough weather. The supervisor of the dredging operation decided to move the operation to a more sheltered area to the northeast, near the point where the dredging had begun but still southwest of the pipeline. According to the supervisor, the plan was to begin dredging there and then move toward the northeast, toward the pipeline. Tennessee Gas was notified by phone that the dredge would soon be approaching the pipeline. Bean's project engineer on the dredge said he questioned a Tennessee Gas supervisor several times about the pipeline's exact location and was told that the location of the pipeline was marked by two pilings, one near either side of the pass.⁷

About 2 p.m., on October 19, a Tennessee Gas inspector boarded the dredge and, using information and a sketch provided by her supervisor, established a 100-foot safety zone in the area of the two pilings. In order to avoid damage to the pipeline, dredging in that area was to be done with the suction pumps only, without using the cutting head. Bean's daily quality control reports showed that the pipeline location identified by Tennessee Gas personnel did not match the location shown on the Corps of Engineers drawings.

Dredging, using only the suction pumps, proceeded across the area of Tiger Pass where the pipeline was believed to be located. The dredge's daily quality control report indicated that the ladder struck an object believed to be the pipeline about 15 feet southwest of the site identified by the Tennessee Gas inspector. Dredging then continued to the northeast to within about 130 feet of the actual pipeline location. Then, on October 20, 1996, because of improving weather, the dredging supervisor decided to return the operation to the Gulf of Mexico end of the channel where weather conditions had previously halted work. The Tennessee Gas inspector left before the dredge was moved, with an agreement that the gas company would be notified when the dredge returned to work in the area of the pipeline.

⁶The junction of Tiger Pass and the Mississippi River was used as a zero reference point by the Corps of Engineers for measuring distances downstream along the center of Tiger Pass. Postaccident measurements determined that the pipeline actually crossed Tiger Pass at station 615+12, or about 92 feet downstream from the Corps of Engineers' approximate location.

⁷These pilings were located at about station 618+10, about 300 feet downstream of the actual pipeline location.

On October 22, after completing its work at the lower end of the pass, the dredge returned, at 9:40 a.m., to an area about 140 feet to the northeast of the area previously identified by Tennessee Gas as the pipeline location. The crew began dredging to the northeast, believing that the operation was outside the safety zone and moving away from the pipeline. In reality, the dredge was moving *toward* the pipeline, which was about 100 feet away. By 9:30 p.m., the cutting head had crossed over the pipeline without incident.

On October 23, at 4:50 a.m., after stopping the dredging to clean the cutting head and reset the swing anchors, the crew dropped a stern spud into the river at about station 615+12 and directly into the Tennessee Gas pipeline, rupturing the pipeline and releasing pressurized natural gas.

At the time of this accident, no signs or markers were in place at the Tiger Pass crossing, and Tennessee Gas officials were unable to explain why they believed the location of that pipeline was marked by the two pilings that were 300 feet southwest of the actual pipeline location. After the accident, the company erected signs in Tiger Pass to alert mariners to the location of the crossing.

In the view of the Safety Board, responsibility for correctly identifying the location of the Tennessee Gas pipeline through Tiger Pass belonged to Tennessee Gas. The Safety Board is therefore concerned about the imprecise method used by Tennessee Gas to locate its pipeline, particularly in a case involving a dredging operation that would, of necessity, have to pass directly over the pipeline, placing the pipeline in jeopardy of being damaged or even ruptured. Tennessee Gas representatives relied on the location of two pilings to determine the location of its pipeline through Tiger Pass, even though company officials, after the accident, could not determine the purpose of the two pilings or explain why company representatives believed they marked the pipeline location.

The actual dredging machinery passed over the pipeline without incident, and had the dredge not, by chance, dropped a spud into the pipeline, the erroneous identification of the pipeline location might have gone unnoted. As the accident revealed, however, the efforts of Tennessee Gas to ensure the safety of its pipeline were inadequate. Those Tennessee Gas employees responsible for making the dredging company aware of the location of the company's pipeline did not employ precise means of locating the pipeline, such as surveying or probing, nor did company procedures require that they do so. The Safety Board concluded that Tennessee Gas took inadequate steps to precisely identify and mark the location of its pipeline through Tiger Pass before dredging operations were undertaken in the pipeline area. The Safety Board has issued the following safety recommendation to Tennessee Gas:

Develop formal, written company procedures for identifying the precise locations of your pipelines that traverse navigable waterways before dredging or similar activities are commenced in the pipeline area. (P-98-26)

Even had Tennessee Gas attempted to use a probe to determine the location of its Tiger Pass pipeline, the company may have encountered a delay in locating the pipeline because of the absence of any markings to indicate the approximate pipeline location. The two pilings that were

thought, erroneously, to be markers were about 300 feet from the pipeline location. Permanent and correctly positioned markers indicating the presence and location of the pipeline would have allowed the correct safety zone to be established on either side of the pipeline. Permanent markers would have served the additional purpose of making commercial and recreational boaters aware of the presence and location of the pipeline, which would reduce the risk of damage to the pipeline caused by vessel anchoring or other activities in which communication with the pipeline operator would not be required or expected. The Safety Board notes that, after the accident, Tennessee Gas took steps to ensure that its pipelines crossing navigable waterways are clearly and permanently marked, but the Board is disappointed that these actions came only after an accident that, under only slightly different circumstances, could have resulted in multiple serious injuries or fatalities.

Over the years, many gas and hazardous liquid pipeline companies have voluntarily installed pipeline markers at navigable waterway pipeline crossings in order to reduce the possibility of pipeline damage by activities such as anchoring, dredging, pile driving, or spud mooring. In 1970, the U.S. Department of Transportation adopted 49 CFR 195.410, which required that hazardous liquid pipeline companies place and maintain line markers over each buried pipeline. The regulation specified the minimum information to be included on the marker and the size and presentation of the information. The regulation required that markers at navigable waterway crossings contain the additional wording "Do Not Anchor or Dredge." In 1975, provisions were added to 49 CFR 192.707 requiring the marking of gas pipelines (in addition to hazardous liquids pipelines) that cross navigable waterways.

In 1981, RSPA issued an advance notice of proposed rulemaking (ANPRM)⁸ requesting comments on:

the problem of interference with underwater pipeline crossings of navigable waterways, the benefits of installing line markers at these crossings, and the size of markers at these crossings:

The preamble indicated that this rulemaking was part of a RSPA program, in accordance with Executive Order 12291, to review existing regulations and revoke or revise those that were not achieving their intended purpose. The preamble also noted two problems with existing regulations. First, the term "navigable waterway" was not defined, leading to a concern that the U.S. Coast Guard's interpretation of this term may be:

broader than reasonably necessary to assure safe pipeline crossings. As a result, the current rules may require markers where there is little or no susceptibility to damage from marine activities, for example, at minor stream crossings which have no vessel traffic and where dredging is unlikely to occur.

The second concern was that in order to be visible and legible from vessels passing through wide bodies of water, the signs marking a pipeline crossing must be "larger, until a point of impracticality or strong environmental objection is reached."

⁸*Federal Register*, Vol. 46, No. 119, June 22, 1981, p. 32287.

In a response to the ANPRM, the Safety Board acknowledged some of the points made by RSPA but stated that:

as a minimum, the MTB [Materials Transportation Bureau] should maintain a requirement for marking the location where pipelines enter or leave navigable waters and that such markers should be similar to those now required for marking the location where pipelines cross roads.

A July 9, 1981, letter from the Corps of Engineers South Atlantic Division in response to the ANPRM stated that division authorities believed that:

crossings [should] be marked on all waterways and streams which have (1) U.S. Coast Guard aids to navigation and (2) regularly scheduled commercial traffic or dredging operations.

The letter stated that some type of marker, as opposed to a legible sign, could be used, but that:

Assuming that dredgers, mariners, and other users of the waterway that have potential to damage the pipeline are forewarned by Corps of Engineers' navigational charts and instructional letters to permittees of the presence of pipeline crossings, these same users will have a need to know the exact vicinity of the crossings.

In January 1983, RSPA issued a Notice of Proposed Rulemaking (NPRM)⁹ proposing the revocation of "the regulations that require pipeline operators to place and maintain line markers at locations where gas and hazardous liquids cross navigable waterways." In the preamble to the notice, RSPA referenced the fact that marine navigation charts show the locations of submarine cables and pipelines and that such charts are required to be kept on board all vessels "with sufficient capacity to damage pipelines." The preamble further noted that the Corps of Engineers has the authority to regulate and grant permits for pipeline crossings of navigable waters and for dredging or other activities that might interfere with such crossings.

Thus, the Corps not only furnishes information about pipeline crossings that is used by mariners, but also conducts a case-by-case review of the safety of pipeline crossings of navigable waters, including the need for line markers.^[10] Furthermore, after a crossing is constructed, the Corps' permitting program in regard to dredging and marine construction activities serves to protect the crossing against damage. It follows, therefore, that the present requirements...for marking navigable waterway crossings are to a large extent unnecessary in light of the Corps of Engineers' practices.

⁹*Federal Register*, Vol. 48, No. 16, January 24, 1983, p. 2987.

¹⁰In a written response to a Safety Board query, the Corps of Engineers stated that the agency does not require pipeline operators to install pipeline markers.

RSPA also noted that Federal requirements were not needed because "most pipeline operators will voluntarily install and maintain line markers at crossings where they consider line markers to be helpful."

The Coast Guard, in its response to the NPRM, stated:

The Coast Guard feels strongly that pipeline crossings under navigable waters should be marked in areas of regular commercial traffic, dredging and other waterside operations. Although charts are helpful for locating pipelines, signs at pipelines more effectively pinpoint the location of a crossing.... The Coast Guard recommends that the requirements for pipeline markings found in 49 CFR 192.707 and 195.410 not be changed.

The Safety Board also responded to the NPRM, stating that the lack of firm data on the effectiveness of markers in preventing damage to underwater pipelines "does not constitute a convincing case that the costs for signing underwater crossings outweigh the safety benefits." The Safety Board stated that "there is substantial merit...in shoreside signing of underwater crossings which can be damaged by vessels anchoring or other causes." In support of its position, the Safety Board made reference to an accident in the Mississippi River delta in which four workers drowned attempting to escape a fire that resulted when a crane barge dropped a mooring spud into an unmarked high-pressure natural gas pipeline.¹¹ The Safety Board response stated that "the premise that voluntary signing will take care of the most exposed pipelines is unrealistic" and cited the NPRM acknowledgement that a substantial portion of the pipeline industry would not object to a continuation of the Federal requirement, if it were more tempered.

In 1983, despite arguments presented by the Safety Board, the Coast Guard, and the Corps of Engineers, RSPA revoked the marking requirements as unnecessary in light of the permit requirements of the Corps of Engineers and the voluntary practices of the pipeline industry.

As shown by other fatal accidents investigated by the Safety Board that involved damage to pipelines traversing navigable waterways,¹² underwater pipelines represent a risk for both recreational and commercial vessels. In light of this accident, RSPA's 1983 revocation of Federal requirements for marking pipeline crossings of navigable waterways appears to have been ill-advised. Even though Tennessee Gas clearly recognized the need for marking the company's underwater pipelines, it had not marked the Tiger Pass crossing, notwithstanding the fact that its own company procedures required it. While Tennessee Gas would probably have eventually marked the crossing in any case, the pipeline would likely have already been marked if Federal requirements for markings had not been eliminated by RSPA in 1983. The Safety Board therefore concluded that, had RSPA not revoked Federal requirements for installing and

¹¹For more information, see Marine Accident Report--*Crane Barge C.L. Dill 10 Fire, Garden Island Bay, Mississippi River Delta, June 5, 1979* (NTSB/MAR-80/9).

¹²In addition to the accident report referenced above involving the *C.L. Dill 10*, see Pipeline Accident Report--*Fire on Board the F/V Northumberland and Rupture of a Natural Gas Pipeline in the Gulf of Mexico Near Sabine Pass, Texas, October 3, 1989* (NTSB/PAR-90/02).

maintaining markings of pipeline crossings of navigable waterways, the pipeline involved in this accident may have been accurately marked, and this accident may not have occurred.

The National Transportation Safety Board therefore makes the following safety recommendation to the Research and Special Programs Administration:

Require pipeline system operators to precisely locate and place permanent markers at sites where their gas and hazardous liquid pipelines cross navigable waterways. (P-98-25)

Also, the Safety Board issued Safety Recommendations P-98-26 and -27 to Tennessee Gas Pipeline Company; M-98-123 to Bean Horizon Corporation; M-98-124 to the Western Dredging Association; P-98-28 to the Interstate Natural Gas Association of America; and P-98-29 to the American Petroleum Institute.

Please refer to Safety Recommendation P-98-25 in your reply. If you need additional information, you may call (202) 314-6469.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

By:


Jim Hall
Chairman



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: October 16, 1998

In reply refer to: P-98-26 and -27

Mr. John W. Somerhalder
President
Tennessee Gas Pipeline Company
1001 Louisiana Street
Houston, Texas 77002

About 4:50 a.m. central daylight time on October 23, 1996, in Tiger Pass, Louisiana,¹ the crew of the Bean Horizon Corporation (Bean) dredge *Dave Blackburn* dropped a stern spud² into the bottom of the channel in preparation for continued dredging operations. The spud struck and ruptured a 12-inch-diameter submerged natural gas steel pipeline owned by Tennessee Gas Pipeline Company.³ The pressurized (about 930 psig) natural gas released from the pipeline enveloped the stern of the dredge and an accompanying tug, the *G.C. Linsmier*. Within seconds of reaching the surface, the natural gas ignited.⁴ The resulting fire destroyed the dredge and the tug. All 28 crewmembers from the dredge and tug escaped into the water or onto nearby vessels.⁵

The National Transportation Safety Board determined that the probable cause of this accident was the failure of Tennessee Gas Pipeline Company to accurately locate the company's pipeline across Tiger Pass before that location was dredged. Contributing to the accident was the revocation by the Research and Special Programs Administration of Federal requirements for all pipeline operators to install and maintain markers to identify the locations at which their pipelines cross navigable waterways.

¹Tiger Pass is a channel through the Mississippi River delta near Venice, Louisiana, that connects the Mississippi River with the Gulf of Mexico. The channel extends partially into the Gulf of Mexico, where the sides of the pass are defined by rock jetties.

²A spud is a large steel shaft that is dropped into the river bottom to serve as an anchor and a pivot during dredging operations.

³At the time of the accident, Tennessee Gas was a division of Tenneco, Inc. Since the accident, it has become a subsidiary of El Paso Energy Corporation.

⁴The ignition source could not be determined but could have been any of a number of electromechanical devices located on the dredge in the area of the escaping gas.

⁵For more information, read Pipeline Accident Summary Report--*Natural Gas Pipeline Rupture and Fire During Dredging of Tiger Pass, Louisiana, October 23, 1996* (NTSB/PAR-98/01/SUM).

In the view of the Safety Board, responsibility for correctly identifying the location of the Tennessee Gas pipeline through Tiger Pass belonged to Tennessee Gas. The Safety Board is therefore concerned about the imprecise method used by Tennessee Gas to locate its pipeline, particularly in a case involving a dredging operation that would, of necessity, have to pass directly over the pipeline, placing the pipeline in jeopardy of being punctured or even severed. Tennessee Gas representatives relied on the location of two pilings to determine the location of its pipeline through Tiger Pass, even though company officials, after the accident, could not determine the purpose of the two pilings or explain why company representatives believed they marked the pipeline location.

The actual dredging machinery passed over the pipeline without incident, and had the dredge not, by chance, dropped a spud into the pipeline, the erroneous identification of the pipeline location might have gone unnoted. As the accident revealed, however, the efforts of Tennessee Gas to ensure the safety of its pipeline were inadequate. Those Tennessee Gas employees responsible for making the dredging company aware of the exact location of the company's pipeline did not employ precise means of locating the pipeline, such as surveying or probing, nor did company procedures require that they do so. The Safety Board concluded that Tennessee Gas took inadequate steps to precisely identify and mark the location of its pipeline through Tiger Pass before dredging operations were undertaken in the pipeline area.

Even had Tennessee Gas attempted to use a probe to determine the location of its Tiger Pass pipeline, the company may have encountered a delay in locating the pipeline because of the absence of any markings to indicate the approximate pipeline location. The two pilings that were thought, erroneously, to be markers were about 300 feet from the pipeline location. Permanent and correctly positioned markers indicating the presence and location of the pipeline would have allowed the correct safety zone to be established on either side of the pipeline. Permanent markers would have served the additional purpose of making commercial and recreational boaters aware of the presence and location of the pipeline, which would reduce the risk of damage to the pipeline caused by vessel anchoring or other activities in which communication with the pipeline operator would not be required or expected. The Safety Board notes that, after the accident, Tennessee Gas took steps to ensure that its pipelines crossing navigable waterways are clearly and permanently marked, but the Board is disappointed that these actions came only after an accident that, under only slightly different circumstances, could have resulted in multiple serious injuries or fatalities.

Over the years, many gas and hazardous liquid pipeline companies have voluntarily installed pipeline markers at navigable waterway pipeline crossings in order to reduce the possibility of pipeline damage by activities such as anchoring, dredging, pile driving, or spud mooring. In 1970, the U.S. Department of Transportation adopted 49 *Code of Federal Regulations* (CFR) 195.410, which required that hazardous liquid pipeline companies place and maintain line markers over each buried pipeline. The regulation specified the minimum information to be included on the marker and the size and presentation of the information. The regulation required that markers at navigable waterway crossings contain the additional wording "Do Not Anchor or Dredge." In 1975, provisions were added to 49 CFR 192.707 requiring the

marking of gas pipelines (in addition to hazardous liquids pipelines) that crossed navigable waterways.

In 1983, despite arguments presented by the Safety Board, the U.S. Coast Guard, and the U.S. Army Corps of Engineers, the Research and Special Programs Administration (RSPA) of the Department of Transportation revoked the marking requirements as unnecessary in light of the permit requirements of the Corps of Engineers and the voluntary practices of the pipeline industry.

As shown by other fatal accidents investigated by the Safety Board that involved damage to pipelines traversing navigable waterways,⁶ underwater pipelines represent a risk for both recreational and commercial vessels. In light of this accident, RSPA's 1983 revocation of Federal requirements for marking pipeline crossings of navigable waterways appears to have been ill-advised. Even though Tennessee Gas clearly recognized the need for marking the company's underwater pipelines, it had not marked the Tiger Pass crossing, notwithstanding the fact that its own company procedures required it. While Tennessee Gas would probably have eventually marked the crossing in any case, the pipeline would likely have already been marked if Federal requirements for markings had not been eliminated by RSPA in 1983. The Safety Board therefore concluded that, had RSPA not revoked Federal requirements for installing and maintaining markings of pipeline crossings of navigable waterways, the pipeline involved in this accident may have been accurately marked, and this accident may not have occurred. The Safety Board has therefore made the following safety recommendation to RSPA:

Require pipeline system operators to precisely locate and place permanent markers at sites where their gas and hazardous liquid pipelines cross navigable waterways. (P-98-25)

The Safety Board notes that about 30 minutes elapsed from the time of the rupture until Tennessee Gas became aware that one of its pipelines may have ruptured, and more than an hour passed before the pipeline was shut down. A check valve downstream of the rupture closed automatically after the break to limit the backflow of product to the rupture, but the supervisory control and data acquisition (SCADA) system used by Tennessee Gas did not report the check valve's closing to pipeline controllers. Had it done so, or had the company's SCADA system been equipped with an alarm that would respond to a change in pressure over a period of time, the pipeline controllers may have been alerted to an anomaly within a certain segment of the pipeline, and the flow of gas feeding the fire in Tiger Pass may have been terminated more quickly than it was.

Insufficient evidence was available to indicate what effect, if any, the earlier shutoff of the gas flow would have had on this accident. Clearly, however, one of the first priorities in any accident involving the release of natural gas should be to curtail the escape of the product. The Safety Board concluded that the delay in recognition by Tennessee Gas that it had experienced a

⁶In addition to the accident report referenced above involving the *C.L. Dill 10*, see Pipeline Accident Report--*Fire on Board the F/V Northumberland and Rupture of a Natural Gas Pipeline in the Gulf of Mexico Near Sabine Pass, Texas, October 3, 1989* (NTSB/PAR-90/02).

pipeline rupture at Tiger Pass was due to its piping system's dynamics during the rupture and the design of its SCADA system.

The National Transportation Safety Board therefore makes the following safety recommendations to Tennessee Gas Pipeline Company:

Develop formal, written company procedures for identifying the precise locations of your pipelines that traverse navigable waterways before dredging or similar activities are commenced in the pipeline area. (P-98-26)


Review your supervisory control and data acquisition system and make the modifications necessary to increase the likelihood that any critical event involving the company's pipelines is quickly and accurately reported to pipeline controllers, allowing them to take timely action to correct or limit the effects of any failure in the pipeline system. (P-98-27)

Also, the Safety Board issued Safety Recommendations P-98-25 to the Research and Special Programs Administration; M-98-123 to Bean Horizon Corporation; M-98-124 to the Western Dredging Association; P-98-28 to the Interstate Natural Gas Association of America; and P-98-29 to the American Petroleum Institute.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any action taken as a result of its safety recommendations. Therefore, it would appreciate a response from you regarding action taken or contemplated with respect to the recommendations in this letter. Please refer to Safety Recommendations P-98-26 and -27 in your reply. If you need additional information, you may call (202) 314-6469.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

By:


Jim Hall
Chairman



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: October 16, 1998

In reply refer to: P-98-28

Mr. Jerald V. Halvorsen
President and Chief Executive Officer
Interstate Natural Gas Association of America
10 G Street, N.E., Suite 700
Washington, D.C. 20002

About 4:50 a.m. central daylight time on October 23, 1996, in Tiger Pass, Louisiana,¹ the crew of the Bean Horizon Corporation (Bean) dredge *Dave Blackburn* dropped a stern spud² into the bottom of the channel in preparation for continued dredging operations. The spud struck and ruptured a 12-inch-diameter submerged natural gas steel pipeline owned by Tennessee Gas Pipeline Company (Tennessee Gas).³ The pressurized (about 930 psig) natural gas released from the pipeline enveloped the stern of the dredge and an accompanying tug, the *G.C. Linsmier*. Within seconds of reaching the surface, the natural gas ignited.⁴ The resulting fire destroyed the dredge and the tug. All 28 crewmembers from the dredge and tug escaped into the water or onto nearby vessels.⁵

The National Transportation Safety Board determined that the probable cause of this accident was the failure of Tennessee Gas Pipeline Company to accurately locate the company's pipeline across Tiger Pass before that location was dredged. Contributing to the accident was the revocation by the Research and Special Programs Administration of Federal requirements for all pipeline operators to install and maintain markers to identify the locations at which their pipelines cross navigable waterways.

¹Tiger Pass is a channel through the Mississippi River delta near Venice, Louisiana, that connects the Mississippi River with the Gulf of Mexico. The channel extends partially into the Gulf of Mexico, where the sides of the pass are defined by rock jetties.

²A spud is a large steel shaft that is dropped into the river bottom to serve as an anchor and a pivot during dredging operations.

³At the time of the accident, Tennessee Gas was a division of Tenneco, Inc. Since the accident, it has become a subsidiary of El Paso Energy Corporation.

⁴The ignition source could not be determined but could have been any of a number of electromechanical devices located on the dredge in the area of the escaping gas.

⁵For more information, read Pipeline Accident Summary Report--*Natural Gas Pipeline Rupture and Fire During Dredging of Tiger Pass, Louisiana, October 23, 1996* (NTSB/PAR-98/01/SUM).

On September 20, 1996, Bean was awarded a U.S. Army Corps of Engineers contract to dredge portions of Tiger Pass, including areas where several underwater pipelines were located. The Corps of Engineers provided Bean with Corps of Engineers drawings showing approximate locations of the pipelines. On these drawings, the Tennessee Gas pipeline was shown as crossing Tiger Pass at centerline station 614+20, or 61,420 feet from the point at which Tiger Pass joins the Mississippi River.⁶ A dredging contract provision, with which Bean complied, required Bean to notify pipeline owners by certified mail at least 7 days before dredging within 500 feet of their pipelines and to verify the pipeline locations.

On September 22, 1996, Bean began dredging about 1,000 feet southwest of the location of the pipeline as shown on the Corps of Engineers drawing. The initial dredging operation was to move toward the Gulf of Mexico and away from the pipeline. On October 17, 1996, Bean received weather reports predicting rough weather. The supervisor of the dredging operation decided to move the operation to a more sheltered area to the northeast, near the point where the dredging had begun but still southwest of the pipeline. According to the supervisor, the plan was to begin dredging there and then move toward the northeast, toward the pipeline. Tennessee Gas was notified by phone that the dredge would soon be approaching the pipeline. Bean's project engineer on the dredge said he questioned a Tennessee Gas supervisor several times about the pipeline's exact location and was told that the location of the pipeline was marked by two pilings, one near either side of the pass.⁷

About 2 p.m., on October 19, 1996, a Tennessee Gas inspector boarded the dredge and, using information and a sketch provided by her supervisor, established a 100-foot safety zone around the area of the two pilings. In order to avoid damage to the pipeline, dredging in that area was done with the suction pumps only, without using the cutting head. Bean's daily quality control reports showed that the pipeline location identified by Tennessee Gas personnel did not match the location shown on the Corps of Engineers drawings.

Dredging, using only the suction pumps, proceeded across the area of Tiger Pass where the pipeline was believed to be located. The dredge's daily quality control report indicated that the ladder struck an object believed to be the pipeline about 15 feet southwest of the location identified by the Tennessee Gas inspector. Dredging then continued to the northeast to about 130 feet of the actual pipeline location. Then, on October 20, 1996, because of improving weather, the dredging supervisor decided to return the operation to the Gulf of Mexico end of the channel where weather conditions had previously halted work. The Tennessee Gas inspector was notified before the dredge was moved, with an agreement that the gas company would be notified when the dredge returned to work in the area of the pipeline.

⁶The junction of Tiger Pass and the Mississippi River was used as a zero reference point by the Corps of Engineers for measuring distances downstream along the center of Tiger Pass. Postaccident measurements determined that the pipeline actually crossed Tiger Pass at station 615+12, or about 92 feet downstream from the Corps of Engineers' approximate location.

⁷These pilings were located at about station 618+10, about 300 feet downstream of the actual pipeline location.

On October 22, after completing its work at the lower end of the pass, the dredge returned, at 9:40 a.m., to an area about 140 feet to the northeast of the area previously identified by Tennessee Gas as the pipeline location. The crew began dredging to the northeast, believing that the operation was outside the safety zone and moving away from the pipeline. In reality, the dredge was moving *toward* the pipeline, which was about 100 feet away. By 9:30 p.m., the cutting head had crossed over the pipeline without incident.

On October 23, at 4:50 a.m., after stopping the dredging to clean the cutting head and reset the swing anchors, the crew dropped a stern spud into the river at about station 615+12 and directly into the Tennessee Gas pipeline, rupturing the pipeline and releasing pressurized natural gas.

At the time of this accident, no signs or markers were in place at the Tiger Pass crossing, and Tennessee Gas officials were unable to explain why they believed the location of that pipeline was marked by the two pilings that were 300 feet southwest of the actual pipeline location. After the accident, the company erected signs in Tiger Pass to alert mariners to the location of the crossing.

In the view of the Safety Board, responsibility for correctly identifying the location of the Tennessee Gas pipeline through Tiger Pass belonged to Tennessee Gas. The Safety Board is therefore concerned about the imprecise method used by Tennessee Gas to locate its pipeline, particularly in a case involving a dredging operation that would, of necessity, have to pass directly over the pipeline, placing the pipeline in jeopardy of being damaged or even ruptured. Tennessee Gas representatives relied on the location of two pilings to determine the location of its pipeline through Tiger Pass, even though company officials, after the accident, could not determine the purpose of the two pilings or explain why company representatives believed they marked the pipeline location.

The actual dredging machinery passed over the pipeline without incident, and had the dredge not, by chance, dropped a spud into the pipeline, the erroneous identification of the pipeline location might have gone unnoted. As the accident revealed, however, the efforts of Tennessee Gas to ensure the safety of its pipeline were inadequate. Those Tennessee Gas employees responsible for making the dredging company aware of the exact location of the company's pipeline did not employ precise means of locating the pipeline, such as surveying or probing, nor did company procedures require that they do so. The Safety Board concluded that Tennessee Gas took inadequate steps to precisely identify and mark the location of its pipeline through Tiger Pass before dredging operations were undertaken in the pipeline area. The Safety Board has issued the following safety recommendation to Tennessee Gas:

Develop formal, written company procedures for identifying the precise locations of your pipelines that traverse navigable waterways before dredging or similar activities are commenced in the pipeline area. (P-98-26)

Even had Tennessee Gas attempted to use a probe to determine the location of its Tiger Pass pipeline, the company may have encountered a delay in locating the pipeline because of the absence of any markings to indicate the approximate pipeline location. The two pilings that were

thought, erroneously, to be markers were about 300 feet from the pipeline location. Permanent and correctly positioned markers indicating the presence and location of the pipeline would have allowed the correct safety zone to be established on either side of the pipeline. Permanent markers would have served the additional purpose of making commercial and recreational boaters aware of the presence and location of the pipeline, which would reduce the risk of damage to the pipeline caused by vessel anchoring or other activities in which communication with the pipeline operator would not be required or expected. The Safety Board notes that, after the accident, Tennessee Gas took steps to ensure that its pipelines crossing navigable waterways are clearly and permanently marked, but the Board is disappointed that these actions came only after an accident that, under only slightly different circumstances, could have resulted in multiple serious injuries or fatalities.

Over the years, many gas and hazardous liquid pipeline companies have voluntarily installed pipeline markers at navigable waterway pipeline crossings in order to reduce the possibility of pipeline damage by activities such as anchoring, dredging, pile driving, or spud mooring. In 1970, the U.S. Department of Transportation adopted 49 *Code of Federal Regulations* (CFR) 195.410, which required that hazardous liquid pipeline companies place and maintain line markers over each buried pipeline. The regulation specified the minimum information to be included on the marker and the size and presentation of the information. The regulation required that markers at navigable waterway crossings contain the additional wording "Do Not Anchor or Dredge." In 1975, provisions were added to 49 CFR 192.707 requiring the marking of gas pipelines (in addition to hazardous liquids pipelines) that cross navigable waterways.

In 1981, the Department of Transportation's Research and Special Programs Administration (RSPA) issued an advance notice of proposed rulemaking (ANPRM)⁸ requesting comments on:

the problem of interference with underwater pipeline crossings of navigable waterways, the benefits of installing line markers at these crossings, and the size of markers at these crossings.

The preamble indicated that this rulemaking was part of a RSPA program, in accordance with Executive Order 12291, to review existing regulations and revoke or revise those that were not achieving their intended purpose. The preamble also noted two problems with existing regulations. First, the term "navigable waterway" was not defined, leading to a concern that the U.S. Coast Guard's interpretation of this term may be:

broader than reasonably necessary to assure safe pipeline crossings. As a result, the current rules may require markers where there is little or no susceptibility to damage from marine activities, for example, at minor stream crossings which have no vessel traffic and where dredging is unlikely to occur.

⁸*Federal Register*, Vol. 46, No. 119, June 22, 1981, p. 32287.

The second concern was that in order to be visible and legible from vessels passing through wide bodies of water, the signs marking a pipeline crossing must be "larger, until a point of impracticality or strong environmental objection is reached."

In a response to the ANPRM, the Safety Board acknowledged some of the points made by RSPA but stated that:

as a minimum, the MTB⁹ should maintain a requirement for marking the location where pipelines enter or leave navigable waters and that such markers should be similar to those now required for marking the location where pipelines cross roads.

A July 9, 1981, letter from the Corps of Engineers South Atlantic Division in response to the ANPRM stated that division authorities believed that:

crossings [should] be marked on all waterways and streams which have (1) U.S. Coast Guard aids to navigation and (2) regularly scheduled commercial traffic or dredging operations.

The letter stated that some type of marker, as opposed to a legible sign, could be used, but that:

Assuming that dredgers, mariners, and other users of the waterway that have potential to damage the pipeline are forewarned by Corps of Engineers' navigational charts and instructional letters to permittees of the presence of pipeline crossings, these same users will have a need to know the exact vicinity of the crossings.

In January 1983, RSPA issued a Notice of Proposed Rulemaking (NPRM)¹⁰ proposing the revocation of "the regulations that require pipeline operators to place and maintain line markers at locations where gas and hazardous liquids cross navigable waterways." In the preamble to the notice, RSPA referenced the fact that marine navigation charts show the locations of submarine cables and pipelines and that such charts are required to be kept on board all vessels "with sufficient capacity to damage pipelines." The preamble further noted that the Corps of Engineers has the authority to regulate and grant permits for pipeline crossings of navigable waters and for dredging or other activities that might interfere with such crossings.

Thus, the Corps not only furnishes information about pipeline crossings that is used by mariners, but also conducts a case-by-case review of the safety of pipeline crossings of navigable waters, including the need for line markers.¹¹

⁹The *Materials Transportation Bureau*, which was created in 1975 and subsumed into RSPA when that agency was established in 1977. The MTB was abolished in 1985, with RSPA retaining the MTB's pipeline safety responsibilities.

¹⁰*Federal Register*, Vol. 48, No. 16, January 24, 1983, p. 2987.

¹¹In a written response to a Safety Board query, the Corps of Engineers stated that the agency does not require pipeline operators to install pipeline markers.

Furthermore, after a crossing is constructed, the Corps' permitting program in regard to dredging and marine construction activities serves to protect the crossing against damage. It follows, therefore, that the present requirements...for marking navigable waterway crossings are to a large extent unnecessary in light of the Corps of Engineers' practices.

RSPA also noted that Federal requirements were not needed because "most pipeline operators will voluntarily install and maintain line markers at crossings where they consider line markers to be helpful."

The Coast Guard, in its response to the NPRM, stated:

The Coast Guard feels strongly that pipeline crossings under navigable waters should be marked in areas of regular commercial traffic, dredging and other waterside operations. Although charts are helpful for locating pipelines, signs at pipelines more effectively pinpoint the location of a crossing.... The Coast Guard recommends that the requirements for pipeline markings found in 49 CFR 192.707 and 195.410 not be changed.

The Safety Board also responded to the NPRM, stating that the lack of firm data on the effectiveness of markers in preventing damage to underwater pipelines "does not constitute a convincing case that the costs for signing underwater crossings outweigh the safety benefits." The Safety Board stated that "there is substantial merit...in shoreside signing of underwater crossings which can be damaged by vessels anchoring or other causes." In support of its position, the Safety Board made reference to an accident in the Mississippi River delta in which four workers drowned attempting to escape a fire that resulted when a crane barge dropped a mooring spud into an unmarked high-pressure natural gas pipeline.¹² The Safety Board response stated that "the premise that voluntary signing will take care of the most exposed pipelines is unrealistic" and cited the NPRM acknowledgement that a substantial portion of the pipeline industry would not object to a continuation of the Federal requirement, if it were more tempered.

In 1983, despite arguments presented by the Safety Board, the Coast Guard, and the Corps of Engineers, RSPA revoked the marking requirements as unnecessary in light of the permit requirements of the Corps of Engineers and the voluntary practices of the pipeline industry.

As shown by other fatal accidents investigated by the Safety Board that involved damage to pipelines traversing navigable waterways,¹³ underwater pipelines represent a risk for both recreational and commercial vessels. In light of this accident, RSPA's 1983 revocation of Federal requirements for marking pipeline crossings of navigable waterways appears to have been ill-

¹²For more information, see Marine Accident Report--*Crane Barge C.L. Dill 10 Fire, Garden Island Bay, Mississippi River Delta, June 5, 1979* (NTSB/MAR-80/9).

¹³In addition to the accident report referenced above involving the *C.L. Dill 10*, see Pipeline Accident Report--*Fire on Board the F/V Northumberland and Rupture of a Natural Gas Pipeline in the Gulf of Mexico Near Sabine Pass, Texas, October 3, 1989* (NTSB/PAR-90/02).

advised. Even though Tennessee Gas clearly recognized the need for marking the company's underwater pipelines, it had not marked the Tiger Pass crossing, notwithstanding the fact that its own company procedures required it. While Tennessee Gas would probably have eventually marked the crossing in any case, the pipeline would likely have already been marked if Federal requirements for markings had not been eliminated by RSPA in 1983. The Safety Board therefore concluded that, had RSPA not revoked Federal requirements for installing and maintaining markings of pipeline crossings of navigable waterways, the pipeline involved in this accident may have been accurately marked, and this accident may not have occurred. The Safety Board has therefore made the following safety recommendation to the RSPA:

Require pipeline system operators to precisely locate and place permanent markers at sites where their gas and hazardous liquid pipelines cross navigable waterways. (P-98-25)

In concert with this objective and in consideration of the delays inherent in the regulatory process, the National Transportation Safety Board makes the following safety recommendation to the Interstate Natural Gas Association of America:

Inform your members of the circumstances of the pipeline rupture and fire in Tiger Pass, Louisiana, and urge them to take the actions necessary to ensure that all their pipelines that cross navigable waterways are accurately located and marked. (P-98-28)

Also, the Safety Board issued Safety Recommendations P-98-25 to the Research and Special Programs Administration; P-98-26 and -27 to Tennessee Gas Pipeline Company; M-98-123 to Bean Horizon Corporation; M-98-124 to the Western Dredging Association; and P-98-29 to the American Petroleum Institute.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any action taken as a result of its safety recommendations. Therefore, it would appreciate a response from you regarding action taken or contemplated with respect to the recommendation in this letter. Please refer to Safety Recommendation P-98-28 in your reply. If you need additional information, you may call (202) 314-6469.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

By:


Jim Hall
Chairman



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: October 16, 1998

In reply refer to: P-98-29

Mr. Red Cavaney
President and Chief Executive Officer
American Petroleum Institute
1220 L Street, N.W.
Washington, D.C. 20005

About 4:50 a.m. central daylight time on October 23, 1996, in Tiger Pass, Louisiana,¹ the crew of the Bean Horizon Corporation (Bean) dredge *Dave Blackburn* dropped a stern spud² into the bottom of the channel in preparation for continued dredging operations. The spud struck and ruptured a 12-inch-diameter submerged natural gas steel pipeline owned by Tennessee Gas Pipeline Company (Tennessee Gas).³ The pressurized (about 930 psig) natural gas released from the pipeline enveloped the stern of the dredge and an accompanying tug, the *G.C. Linsmier*. Within seconds of reaching the surface, the natural gas ignited.⁴ The resulting fire destroyed the dredge and the tug. All 28 crewmembers from the dredge and tug escaped into the water or onto nearby vessels.⁵

The National Transportation Safety Board determined that the probable cause of this accident was the failure of Tennessee Gas Pipeline Company to accurately locate the company's pipeline across Tiger Pass before that location was dredged. Contributing to the accident was the revocation by the Research and Special Programs Administration of Federal requirements for all pipeline operators to install and maintain markers to identify the locations at which their pipelines cross navigable waterways.

¹Tiger Pass is a channel through the Mississippi River delta near Venice, Louisiana, that connects the Mississippi River with the Gulf of Mexico. The channel extends partially into the Gulf of Mexico, where the sides of the pass are defined by rock jetties.

²A spud is a large steel shaft that is dropped into the river bottom to serve as an anchor and a pivot during dredging operations.

³At the time of the accident, Tennessee Gas was a division of Tenneco, Inc. Since the accident, it has become a subsidiary of El Paso Energy Corporation.

⁴The ignition source could not be determined but could have been any of a number of electromechanical devices located on the dredge in the area of the escaping gas.

⁵For more information, read Pipeline Accident Summary Report--*Natural Gas Pipeline Rupture and Fire During Dredging of Tiger Pass, Louisiana, October 23, 1996* (NTSB/PAR-98/01/SUM).

On September 20, 1996, Bean was awarded a U.S. Army Corps of Engineers contract to dredge portions of Tiger Pass, including areas where several underwater pipelines were located. The Corps of Engineers provided Bean with Corps of Engineers drawings showing the approximate locations of the pipelines. On these drawings, the Tennessee Gas pipeline was shown as crossing Tiger Pass at centerline station 614+20, or 61,420 feet from the point at which Tiger Pass joins the Mississippi River.⁶ A dredging contract provision, with which Bean complied, required Bean to notify pipeline owners by certified mail at least 7 days before dredging within 500 feet of their pipelines and to verify the pipeline locations.

On September 22, 1996, Bean began dredging about 1,000 feet southwest of the location of the pipeline as shown on the Corps of Engineers drawing. The initial dredging operation was to move toward the Gulf of Mexico and away from the pipeline. On October 17, the crew received weather reports predicting rough weather. The supervisor of the dredging operation decided to move the operation to a more sheltered area to the northeast, near the point where the dredging had begun but still southwest of the pipeline. According to the supervisor, the plan was to begin dredging there and then move toward the northeast, toward the pipeline. Tennessee Gas was notified by phone that the dredge would soon be approaching the pipeline. Bean's project engineer on the dredge said he questioned a Tennessee Gas supervisor several times about the pipeline's exact location and was told that the location of the pipeline was marked by two pilings, one near either side of the pass.⁷

About 2 p.m., on October 19, a Tennessee Gas inspector boarded the dredge and, using information and a sketch provided by her supervisor, established a 100-foot safety zone in the area of the two pilings. In order to avoid damage to the pipeline, dredging in that area was to be done with the suction pumps only, without using the cutting head. Bean's daily quality control reports showed that the pipeline location identified by Tennessee Gas personnel did not match the location shown on the Corps of Engineers drawings.

Dredging, using only the suction pumps, proceeded across the area of Tiger Pass where the pipeline was believed to be located. The dredge's daily quality control report indicated that the ladder struck an object believed to be the pipeline about 15 feet southwest of the site identified by the Tennessee Gas inspector. Dredging then continued to the northeast to within about 130 feet of the actual pipeline location. Then, on October 20, 1996, because of improving weather, the dredging supervisor decided to return the operation to the Gulf of Mexico end of the channel where weather conditions had previously halted work. The Tennessee Gas inspector left before the dredge was moved, with an agreement that the gas company would be notified when the dredge returned to work in the area of the pipeline.

⁶The junction of Tiger Pass and the Mississippi River was used as a zero reference point by the Corps of Engineers for measuring distances downstream along the center of Tiger Pass. Postaccident measurements determined that the pipeline actually crossed Tiger Pass at station 615+12, or about 92 feet downstream from the Corps of Engineers' approximate location.

⁷These pilings were located at about station 618+10, about 300 feet downstream of the actual pipeline location.

On October 22, after completing its work at the lower end of the pass, the dredge returned, at 9:40 a.m., to an area about 140 feet to the northeast of the area previously identified by Tennessee Gas as the pipeline location. The crew began dredging to the northeast, believing that the operation was outside the safety zone and moving away from the pipeline. In reality, the dredge was moving *toward* the pipeline, which was about 100 feet away. By 9:30 p.m., the cutting head had crossed over the pipeline without incident.

On October 23, at 4:50 a.m., after stopping the dredging to clean the cutting head and reset the swing anchors, the crew dropped a stern spud into the river at about station 615+12 and directly into the Tennessee Gas pipeline, rupturing the pipeline and releasing pressurized natural gas.

At the time of this accident, no signs or markers were in place at the Tiger Pass crossing, and Tennessee Gas officials were unable to explain why they believed the location of that pipeline was marked by the two pilings that were 300 feet southwest of the actual pipeline location. After the accident, the company erected signs in Tiger Pass to alert mariners to the location of the crossing.

In the view of the Safety Board, responsibility for correctly identifying the location of the Tennessee Gas pipeline through Tiger Pass belonged to Tennessee Gas. The Safety Board is therefore concerned about the imprecise method used by Tennessee Gas to locate its pipeline, particularly in a case involving a dredging operation that would, of necessity, have to pass directly over the pipeline, placing the pipeline in jeopardy of being damaged or even ruptured. Tennessee Gas representatives relied on the location of two pilings to determine the location of its pipeline through Tiger Pass, even though company officials, after the accident, could not determine the purpose of the two pilings or explain why company representatives believed they marked the pipeline location.

The actual dredging machinery passed over the pipeline without incident, and had the dredge not, by chance, dropped a spud into the pipeline, the erroneous identification of the pipeline location might have gone unnoted. As the accident revealed, however, the efforts of Tennessee Gas to ensure the safety of its pipeline were inadequate. Those Tennessee Gas employees responsible for making the dredging company aware of the exact location of the company's pipeline did not employ precise means of locating the pipeline, such as surveying or probing, nor did company procedures require that they do so. The Safety Board concluded that Tennessee Gas took inadequate steps to precisely identify and mark the location of its pipeline through Tiger Pass before dredging operations were undertaken in the pipeline area. The Safety Board has issued the following safety recommendation to Tennessee Gas Pipeline Company:

Develop formal, written company procedures for identifying the precise locations of your pipelines that traverse navigable waterways before dredging or similar activities are commenced in the pipeline area. (P-98-26)

Even had Tennessee Gas attempted to use a probe to determine the location of its Tiger Pass pipeline, the company may have encountered a delay in locating the pipeline because of the absence of any markings to indicate the approximate pipeline location. The two pilings that were

thought, erroneously, to be markers were about 300 feet from the pipeline location. Permanent and correctly positioned markers indicating the presence and location of the pipeline would have allowed the correct safety zone to be established on either side of the pipeline. Permanent markers would have served the additional purpose of making commercial and recreational boaters aware of the presence and location of the pipeline, which would reduce the risk of damage to the pipeline caused by vessel anchoring or other activities in which communication with the pipeline operator would not be required or expected. The Safety Board notes that, after the accident, Tennessee Gas took steps to ensure that its pipelines crossing navigable waterways are clearly and permanently marked, but the Board is disappointed that these actions came only after an accident that, under only slightly different circumstances, could have resulted in multiple serious injuries or fatalities.

Over the years, many gas and hazardous liquid pipeline companies have voluntarily installed pipeline markers at navigable waterway pipeline crossings in order to reduce the possibility of pipeline damage by activities such as anchoring, dredging, pile driving, or spud mooring. In 1970, the U.S. Department of Transportation adopted 49 *Code of Federal Regulations* (CFR) 195.410, which required that hazardous liquid pipeline companies place and maintain line markers over each buried pipeline. The regulation specified the minimum information to be included on the marker and the size and presentation of the information. The regulation required that markers at navigable waterway crossings contain the additional wording "Do Not Anchor or Dredge." In 1975, provisions were added to 49 CFR 192.707 requiring the marking of gas pipelines (in addition to hazardous liquids pipelines) that cross navigable waterways.

In 1981, The Department of Transportation's Research and Special Programs Administration (RSPA) issued an advance notice of proposed rulemaking (ANPRM)⁸ requesting comments on:

the problem of interference with underwater pipeline crossings of navigable waterways, the benefits of installing line markers at these crossings, and the size of markers at these crossings.

The preamble indicated that this rulemaking was part of a RSPA program, in accordance with Executive Order 12291, to review existing regulations and revoke or revise those that were not achieving their intended purpose. The preamble also noted two problems with existing regulations. First, the term "navigable waterway" was not defined, leading to a concern that the U.S. Coast Guard's interpretation of this term may be:

broader than reasonably necessary to assure safe pipeline crossings. As a result, the current rules may require markers where there is little or no susceptibility to damage from marine activities, for example, at minor stream crossings which have no vessel traffic and where dredging is unlikely to occur.

⁸ *Federal Register*, Vol. 46, No. 119, June 22, 1981, p. 32287.

The second concern was that in order to be visible and legible from vessels passing through wide bodies of water, the signs marking a pipeline crossing must be "larger, until a point of impracticality or strong environmental objection is reached."

In a response to the ANPRM, the Safety Board acknowledged some of the points made by RSPA but stated that:

as a minimum, the MTB⁹ should maintain a requirement for marking the location where pipelines enter or leave navigable waters and that such markers should be similar to those now required for marking the location where pipelines cross roads.

A July 9, 1981, letter from the Corps of Engineers South Atlantic Division in response to the ANPRM stated that division authorities believed that:

crossings [should] be marked on all waterways and streams which have (1) U. S. Coast Guard aids to navigation and (2) regularly scheduled commercial traffic or dredging operations.

The letter stated that some type of marker, as opposed to a legible sign, could be used, but that:

Assuming that dredgers, mariners, and other users of the waterway that have potential to damage the pipeline are forewarned by Corps of Engineers' navigational charts and instructional letters to permittees of the presence of pipeline crossings, these same users will have a need to know the exact vicinity of the crossings.

In January 1983, RSPA issued a Notice of Proposed Rulemaking (NPRM)¹⁰ proposing the revocation of "the regulations that require pipeline operators to place and maintain line markers at locations where gas and hazardous liquids cross navigable waterways." In the preamble to the notice, RSPA referenced the fact that marine navigation charts show the locations of submarine cables and pipelines and that such charts are required to be kept on board all vessels "with sufficient capacity to damage pipelines." The preamble further noted that the Corps of Engineers has the authority to regulate and grant permits for pipeline crossings of navigable waters and for dredging or other activities that might interfere with such crossings.

Thus, the Corps not only furnishes information about pipeline crossings that is used by mariners, but also conducts a case-by-case review of the safety of pipeline crossings of navigable waters, including the need for line markers.¹¹

⁹The *Materials Transportation Bureau*, which was created in 1975 and subsumed into RSPA when that agency was established in 1977. The MTB was abolished in 1985, with RSPA retaining the MTB's pipeline safety responsibilities.

¹⁰*Federal Register*, Vol. 48, No. 16, January 24, 1983, p. 2987.

¹¹In a written response to a Safety Board query, the Corps of Engineers stated that the agency does not require pipeline operators to install pipeline markers.

Furthermore, after a crossing is constructed, the Corps' permitting program in regard to dredging and marine construction activities serves to protect the crossing against damage. It follows, therefore, that the present requirements...for marking navigable waterway crossings are to a large extent unnecessary in light of the Corps of Engineers' practices.

RSPA also noted that Federal requirements were not needed because "most pipeline operators will voluntarily install and maintain line markers at crossings where they consider line markers to be helpful."

The Coast Guard, in its response to the NPRM, stated:

The Coast Guard feels strongly that pipeline crossings under navigable waters should be marked in areas of regular commercial traffic, dredging and other waterside operations. Although charts are helpful for locating pipelines, signs at pipelines more effectively pinpoint the location of a crossing.... The Coast Guard recommends that the requirements for pipeline markings found in 49 CFR 192.707 and 195.410 not be changed.

The Safety Board also responded to the NPRM, stating that the lack of firm data on the effectiveness of markers in preventing damage to underwater pipelines "does not constitute a convincing case that the costs for signing underwater crossings outweigh the safety benefits." The Safety Board stated that "there is substantial merit...in shoreside signing of underwater crossings which can be damaged by vessels anchoring or other causes." In support of its position, the Safety Board made reference to an accident in the Mississippi River delta in which four workers drowned attempting to escape a fire that resulted when a crane barge dropped a mooring spud into an unmarked high-pressure natural gas pipeline.¹² The Safety Board response stated that "the premise that voluntary signing will take care of the most exposed pipelines is unrealistic" and cited the NPRM acknowledgement that a substantial portion of the pipeline industry would not object to a continuation of the Federal requirement, if it were more tempered.

In 1983, despite arguments presented by the Safety Board, the Coast Guard, and the Corps of Engineers, RSPA revoked the marking requirements as unnecessary in light of the permit requirements of the Corps of Engineers and the voluntary practices of the pipeline industry.

As shown by other fatal accidents investigated by the Safety Board that involved damage to pipelines traversing navigable waterways,¹³ underwater pipelines represent a risk for both recreational and commercial vessels. In light of this accident, RSPA's 1983 revocation of Federal requirements for marking pipeline crossings of navigable waterways appears to have been ill-

¹²For more information, see Marine Accident Report--*Crane Barge C.L. Dill 10 Fire, Garden Island Bay, Mississippi River Delta, June 5, 1979* (NTSB/MAR-80/9).

¹³In addition to the accident report referenced above involving the *C.L. Dill 10*, see Pipeline Accident Report--*Fire on Board the F/V Northumberland and Rupture of a Natural Gas Pipeline in the Gulf of Mexico Near Sabine Pass, Texas, October 3, 1989* (NTSB/PAR-90/02).

advised. Even though Tennessee Gas clearly recognized the need for marking the company's underwater pipelines, it had not marked the Tiger Pass crossing, notwithstanding the fact that its own company procedures required it. While Tennessee Gas would probably have eventually marked the crossing in any case, the pipeline would likely have already been marked if Federal requirements for markings had not been eliminated by RSPA in 1983. The Safety Board therefore concluded that, had RSPA not revoked Federal requirements for installing and maintaining markings of pipeline crossings of navigable waterways, the pipeline involved in this accident may have been accurately marked, and this accident may not have occurred. The Safety Board has therefore made the following safety recommendation to RSPA:

Require pipeline system operators to precisely locate and place permanent markers at sites where their gas and hazardous liquid pipelines cross navigable waterways. (P-98-25)

In concert with this objective and in consideration of the delays inherent in the regulatory process, the National Transportation Safety Board makes the following safety recommendation to the American Petroleum Institute:


Inform your members of the circumstances of the pipeline rupture and fire in Tiger Pass, Louisiana, and urge them to take the actions necessary to ensure that all their pipelines that cross navigable waterways are accurately located and marked. (P-98-29)

Also, the Safety Board issued Safety Recommendations P-98-25 to the Research and Special Programs Administration; P-98-26 and -27 to Tennessee Gas Pipeline Company; M-98-123 to Bean Horizon Corporation; M-98-124 to the Western Dredging Association; and M-98-28 to the Interstate Natural Gas Association of America.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any action taken as a result of its safety recommendations. Therefore, it would appreciate a response from you regarding action taken or contemplated with respect to the recommendation in this letter. Please refer to Safety Recommendation M-98-29 in your reply. If you need additional information, you may call (202) 314-6469.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

By:


Jim Hall
Chairman

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